PB90-178047

Superfund Record of Decision (EPA Region 3): Henderson Road NPL Site, Upper Merion Township, Pennsylvania (Second Remedial Action), September 1989

(U.S.) Environmental Protection Agency, Washington, DC

29 Sep 89

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15. Supplementary Notes

16. Abstract (Limit: 200 words)

The Henderson Road site is a 7.6-acre site in Upper Merion Township, Pennsylvania. O'Hara Sanitation Company, Inc. has used the site for waste storage, waste recycling, vehicle maintenance, and parking and office facilities since 1974. The area surrounding the site is zoned for industrial and residential use. The site is bounded by the Pennsylvania Turnpike, the Conrail property including train tracks, Henderson Road, and Frog Run. The Upper Merion Reservoir, located 2,000 feet upgradient of the site, serves as part of the water source for approximately 228,000 people. Prior to 1974 the site was operated by the Ellis Concrete Company as a concrete preparation plant. During this operation cinders may have been placed on the western portion of the site and on adjacent railroad property. In 1974 William J. O'Hara, Inc. began landfilling trash and construction debris on central and eastern portions of the site until 1984. Between 1974 and 1977 William J. O'Hara, Inc. alledgedly injected industrial waste into a 160-foot onsite well. Furthermore, liquid waste, sludge, and drums may have been disposed of in the landfill. The first operable unit for this site, as described in a June 1988 Record of Decision, included pumping and treatment, using air strippers, of contaminated ground water. This will be accompanied by additional characterization of the injection well, exavation of oil pit sediment if found, removal of significant waste within the well if feasible, institutional controls, further characterization of saturated and unsaturated zones, possibly direct (Continued on next page)

17. Document Analysis a. Descriptors
Record of Decision - Henderson Road, PA
Second Remedial Action - Final
Contaminated Media: soil, gw
Key Contaminants: VOCs (benzene, TCE, PCE, toluene), organics (PAHs)

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement

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None

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21. No. of Pages
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September 1989

EPA

Superfund Record of Decision:

Henderson Road, PA

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16. Abstract (continued)

treatment in the unsaturated zone, monitoring, and periodic evaluation of cleanup goals. The second operable unit addresses all surface sources of contamination at the site. The primary contaminants of concern affecting the soil and ground water are VOCs including benzene, toluene, PCE, and TCE; and other organics including PAHs. The predominant carcinogenic risk for the landfill operable unit (LOU) is based on the prediction of movement of leachate to groundwater. Of the 19 chemicals of concern identified for the LOU, bis (2-chloroethyl) ether and six volatiles are considered by EPA to pose the greatest threat to ground water. Other routes of exposure include those from ingestion of soil and inhalation of fugative emissions.

The selected remedial action for this operable unit includes installation of erosion controls; regrading and capping, including possibly moving the onsite watermain; installing a short- and long-term leachate collection system with treatment and discharge to be determined during design; excavation and onsite consolidation of trash, soil, and cinder currently located at the adjacent Turnpike property with appropriate remediation of wastes left in place at the Turnpike property; further sample collection and data evaluation in the western portion of the site leading to a determination regarding treatment and/or capping in that area, and contingent ground water recovery; monitoring of ground water and leachate; and institutional controls. The estimated present worth cost for this remedial action is $7,265,000, which includes an annual O&M cost of $213,260.

PORTIONS OF THIS REPORT ARE NOT FULLY LEGIBLE DUE TO THE HISTORICAL NATURE OF SOME OF THE MATERIAL. HOWEVER, IT IS THE BEST REPRODUCTION AVAILABLE FROM THE COPY SENT TO NTIS.

RECORD OF DECISION
DECLARATION

SITE NAME AND LOCATION

Henderson Road NPL Site
362-372 South Henderson Road
Upper Merion Township, Pennsylvania

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for the Henderson Road NPL Site ("the site") Landfill Operable Unit in Upper Merion Township. The selected remedial action has been developed in accordance with the Comprehensive Environmental Response and Liability Act of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1976, and, to the extent practicable, the National Contingency Plan. The attached index (Exhibit 1) identifies the items which comprise the administrative record upon which the selection of the remedial action is based.

The Commonwealth of Pennsylvania has concurred on the selected remedy.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this operable unit, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDY

This operable unit is the second of two operable units that address contamination at the site. This operable unit, the Landfill Operable Unit, addresses soils, surface water, air, and ground water potentially impacted by previous landfilling, surface placement, and possible trenching on-site, in addition to potential leakage from on-site underground storage tanks. The first operable unit, the Injection Well Operable Unit, addresses ground water contamination caused by injection of hazardous substances into an on-site well prior to 1977 and the risks associated with exposure to ground water contaminated from that well.

The major components of the selected remedy for the Landfill Operable Unit include:

- run-on, run-off, and erosion controls
- short and long-term leachate collection
- capping over the landfill,including moving the on-site water main unless a means of maintaining the water line on-site and addressing remedial objectives and State ARARs is designed

- ground water recovery and treatment if, after two years of pumping ground water beneath the site for the Injection Well Operable Unit, site-related ground water contamination is detected or near at the property line and ground water is still leaving the site

- movement to the Henderson Road site of trash, shallow soils and shallow cinder fill from the Pennsylvania Turnpike property adjacent to the site, additional characterization of the Turnpike property, and appropriate remediation to address wastes, contaminated soil and bedrock left in place, if any, and leachate

- monitoring in coordination with the Injection Well Operable Unit

- institutional controls on-site and on adjacent properties to restrict activities that would interfere with remediation at the site

- further sample collection and data evaluation in the western portion of the site, in coordination with the Injection Well Operable Unit, leading to a determination whether to pilot test for, and possibly, commence in-situ volatilization or other treatment and/or capping in that area

- periodic reevaluation of clean-up goals throughout operation and maintenance, in coordination with the Injection Well Operable Unit.

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to this remedial action, and is cost-effective. This remedy satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility or volume as a principal element and utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable. However, treatment of landfilled wastes and contaminated soils in the central and eastern portions of the site was not found to be practicable, so that this remedy does not satisfy the statutory preference for treatment as a principal element of the remedy.

The selected remedy may result in hazardous substances remaining on-site above health-based levels. Therefore, a review will be conducted within five years after commencement of the remedial action and every five years thereafter, throughout operation and maintenance. This review will be conducted in consonance with the five-year review for the Injection Well Operable Unit to evaluate whether technologies implemented provide adequate protection of human health and the environment, whether additional treatment is appropriate, whether progress is being made in meeting clean-up goals, and whether clean-up goals should be revised.

Edwin B. Erickson
Regional Administrator

9/29/89
Date

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Edwin B. Erickson
Regional Administrator

Date

CONCURRENCES

SYMBOL	3HW21	2HW20	3HW20	3DV02	3HW60	3DV00	3HW00 3RC21	3RA00
SURNAME	Valls	Kryszczun RKK	Ferdas	Voltaggio	Greaves	Bregman	Wassersug Walters	Laskowski
	9/23/89	9/29					WW 9/29/89	

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RECORD OF DECISION
DECISION SUMMARY

I. SITE NAME, LOCATION, AND DESCRIPTION

The Henderson Road NPL Site ("the site") consists of 7.6 acres located at 362-372 South Henderson Road in Upper Merion Township, in southeastern Pennsylvania (see Exhibit 2). O'Hara Sanitation Company, Inc. occupies the site with several small businesses. O'Hara Sanitation Company presently uses the site for waste storage, waste recycling, vehicle maintenance and parking, and office facilities.

The site is bounded on the north by the Pennsylvania Turnpike ("the Turnpike"), to the east by the Southeastern Pennsylvania Transportation Authority Norristown High-Speed Line right-of-way and including a stream bed, on the south by property owned by Consolidated Rail Corporation ("Conrail") and including railroad tracks, to the west by South Henderson Road, and on the northwest by Chester Valley Railroad tracks, owned by Conrail. Property directly northwest of the Chester Valley Railroad tracks also is owned by the Pennsylvania Turnpike Commission. Land in the vicinity of the site is zoned for light industrial, heavy industrial, and residential use (see Exhibit 3).

The site is approximately 2000 feet south and upgradient of the Upper Merion Reservoir ("UMR"), a former limestone quarry. Philadelphia Suburban Water Company pumps ("PSWC") ground water in UMR at a rate of 7.5 million gallons a day as one of several sources of water serving PSWC's 228,000 customers. This pumping has lowered the ground water at the site to about 120 to 160 feet below the surface.

The population within 1,500 feet of the site consists mainly of employees of businesses that surround the site. Within one mile of the site the total estimated residential population is 5,000. The nearest residential dwelling is 560 feet southwest of site. The nearest school is 3,000 feet south of the site.

The site is located in the Chester Valley, an east-west trending subdivision of the Piedmont Uplands. The Chester Valley contains highly folded dolomite and limestone rocks which dip to the south-southwest. Bedrock is encountered on-site at depths of 34 and 46 feet. Sinkholes are common in the Chester Valley, including the area of the site, due to dissolution and subsequent collapse of the dolomite and limestone bedrock.

The Piedmont Uplands is characterized by mature, dissected rolling hills. On-site topography has changed extensively since the 1970's, due to grading and regrading associated with operations. At present, the highest on-site elevation is in the northwest corner, approximately 190 feet above sea level.

The stream bed located at the east end of the site is the lowest on-site point of elevation, at approximately 126 feet above sea level. Land surfaces slope toward the central portion of the site from the north, south, west, and east, at slopes of approximately two percent. At the extreme east of the site, land surfaces slope at approximately eight percent and increase to 40 percent toward the stream bed. A level area at an elevation of approximately 160 feet lies in the northern and western portions of the site (see Exhibit 4). A corrugated metal storm sewer line presently runs through the south end of the site and empties into the stream bed. A 36-inch water transmission main, owned by PSWC, is situated along the eastern portion of the site parallel to the stream bed. A ponded area used to occupy the south central portion of the site. Much of the western portion of the site is paved at present.

UMR is one of two primary surface water bodies in the vicinity of the site. However, no surface water body empties into UMR. The second major surface water body associated with the site is the adjacent stream, Frog Run, which is intermittent. This stream receives runoff from the entire site south and east of the railroad spur in the northwest corner of the site and a small area west of the site along Henderson Road (see Exhibit 5). The stream alternates between gaining and losing reaches until it ultimately discharges to the Schuylkill River.

Frog Run is dry except during and immediately after stormwater runoff events. The stream has no Commonwealth of Pennsylvania classification. Since the Schuylkill River is classified as a cold water fisheries stream, Frog Run would be classified as a cold water fisheries stream. The stream bed is classified as outside the 500-year flood boundary.

No species of special concern or exemplary natural communities exist in in the vicinity of the site as determined by the Pennsylvania Natural Diversity Inventory. No endangered reptiles or amphibians are expected to inhabit the area. No designated wetlands occur in the vicinity of the site.

The aquifer beneath the site and from which UMR draws water meets the requirements of a Class IIA Aquifer, defined under the EPA Ground Water Protection Program as a current source of drinking water. According to the Ground Water Protection Program, Class II ground water should "achieve the selected clean-up level throughout the area of attainment within the shortest time technically feasible."

Ground water pumping at UMR draws down water from an approximate area of 2.4 square miles, which includes the site and ground water that is induced to flow from the bed of the Schuylkill River. Ground water and associated contaminants are expected to ultimately flow from the site to the UMR via fractures and related solution features in a direction which predominantly follows strike but also has a northerly component.

Prior to 1974, the site was operated by Ellis Concrete Company as a concrete preparation plant. Cinders may have been placed on the western and central portions of the site during the time that Ellis Concrete operated there and/or later, by William J. O'Hara, Inc. Also, a railroad spur once ran through the eastern portion of the site. This spur and the adjacent Conrail tracks may have been built on cinders which contain hazardous substances.

In 1974 the site was purchased by principals of William J. O'Hara, Inc. William J. O'Hara, Inc. landfilled trash and construction debris on the central and eastern portions of the site and on the adjacent Conrail and Turnpike properties through 1984. O'Hara also may have disposed liquid waste, sludge and drums in the landfill and placed cinders on-site. Between 1974 and 1977, O'Hara injected industrial waste into a 160-foot well (the "injection well") inside the garage located on western portion of the property (See Exhibit 4).

At present, the principal site owner is Betty O'Hara, Trustee. O'Hara Sanitation Company operates the site as a truckyard and waste transfer facility. An auto repair and drilling company also occupy the western end of the site. O'Hara is planning to move the waste transfer operations to a facility north of the Turnpike property.

Surface and subsurface features associated with the Henderson Road Site Landfill Operable Unit ("LOU") include:

- shallow sediments, soils, cinders and trash;
- all local surface drainage;
- the adjacent intermittent stream; and
- ground water and UMR water affected and potentially affected by disposal of hazardous substances onto the site from the surface, including underground tanks and pipes.

The Injection Well Operable Unit ("IWOU") pertains to ground water and UMR contamination caused by or potentially caused by disposal of hazardous substances into the injection well. The IWOU is discussed in detail in a previous Remedial Investigation and Feasibility Study ("RI/FS") and Record of Decision ("ROD").

II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

EPA detected contaminated ground water beneath the site in 1981 and proposed the site for the National Priorities List in 1983. The site was finalized on the National Priorities List in 1984. In December, 1985, an Administrative Order on Consent was signed by EPA and nine respondents for the completion of an RI and FS. In 1987, EPA divided the site into two operable units — the IWOU and LOU.

In June, 1988, the respondents completed the IWOU RI/FS and EPA selected a remedy in a ROD for that operable unit. In May, 1989, a Consent Decree was entered for implementation of the remedy for the IWOU by nine settlors. Under that Consent Decree, the settlors are investigating further the area around the injection well to identify whether direct remediation is appropriate there. On-site wells will be pumped to keep ground water from leaving the site. Off-site recovery of ground water also may be implemented under the Consent Decree. Recovered ground water will be treated with air strippers prior to discharge either to the local sewage treatment plan or the adjacent stream. Some treated water may be reinjected to the aquifer or be provided to PSWC for distribution. On and off-site wells will be monitored throughout the Operation and Maintenance ("O&M") Phase. A treatment system has already been installed at the one private well, operated by McIlvain Lumber Company, considered to be affected by the IWOU at present. Finally, the settlors will submit a series of reports on the status of the performance of Remedial Design and Remedial Action ("RD/RA"), including an "Unsaturated and Saturated Zone(s) Investigation Report(s)," a "Design and Construction Phases Plan," and "Bi-annual O&M Reports." The work to be performed is outlined in detail in the Statement of Work ("SOW") attached to the Consent Decree.

The respondents to the Administrative Order submitted a draft FS for the LOU to EPA in April, 1989. In May, 1989, the respondents submitted a draft RI for the LOU. EPA made the draft RI/FS and Proposed Plan for the LOU available for public review on June 12, 1989. Public comments on the Proposed Plan are included in the Administrative Record (see Exhibit 1).

The final RI/FS was due to be submitted to EPA on September 18, 1989, but none has been received to date. The respondents are in noncompliance with the Administrative Order because of this missed deadline.

Special notice letters for RD/RA of the Landfill Operable Unit have been sent to potentially responsible parties. In July, 1989, certain potentially responsible parties offered to conduct an expedited characterization of the western portion of the LOU. No "good faith" offer has been received and EPA's moratorium on RD/RA activity has concluded.

The Pennsylvania Department of Environmental Resources ("PA DER") has participated in all of EPA's activities related to both operable units.

III. COMMUNITY RELATIONS HISTORY

Public comment period for the LOU RI/FS and Proposed Plan closed on July 12, 1989. Although opportunity for a public meeting was made available, no request for such a meeting was received. Representatives from PA DER, Department of Interior, Fish and Wildlife Service, and National Oceanic and Atmospheric Administration have participated in development of the LOU RI/FS since the first draft was produced.

EPA notified the Pennsylvania Turnpike Commission that work being considered for the LOU RD/RA is expected to affect the Turnpike property. The Turnpike Commission expressed an interest in excavating trash, constructing a retaining wall, and backfilling on the Turnpike property in order to expand the Turnpike to six lanes. All work would be done within the existing right of way. The Commission notified EPA that the Commission plans to conduct a five-month study within the right of way to characterize the types and extent of waste and to design the retaining wall. EPA has offered to work closely with the Turnpike Commission in development of that study.

The Responsiveness Summary attached to this ROD provides a response to each of the significant comments received from the public.

IV. SCOPE AND ROLE OF OPERABLE UNIT AND RESPONSE ACTION

This ROD for the LOU addresses the second of two planned activities at the site. This ROD addresses endangerment and potential endangerment from contaminated or potentially contaminated soils, surface water, ground water, sediment and air related to landfilling, possible trenching, spilling, placement, and storage of hazardous waste at the site. The IWOU ROD addressed ground water contamination and UMR contamination caused by or potentially caused by disposal of hazardous substances into the injection well. Together, the RODs for the Landfill and Injection Well Operable Units address exposure and potential exposure to all contamination resulting from site activities.

V. SITE CHARACTERISTICS

A. Fill material, tanks and leachate in LOU

Approximately 125,000 cubic yards of construction and demolition debris and domestic waste fill the central and eastern portions of the site and Conrail and Turnpike properties, covering about 7.2 acres. Fill thickness extends approximately three to 18 feet below the surface and generally increases from west to southeast. 33,000 cubic yards of black cinders and broken cinder blocks are estimated to cover about two acres in the western and central portions of the site and Conrail and Turnpike properties*.

About 16,000 cubic yards of trash fill and cinders, covering approximately one acre, are located on the adjacent Conrail property to the south. 5,230 cubic yards of trash and cinder fill, covering about one-third acre, are estimated to be located on Turnpike property. Finally, three on-site underground diesel fuel storage tanks, one on-site underground gasoline storage tank, and three septic tanks are included as part of the LOU.

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* Cinders have been observed in the western and central portions of the site and the Turnpike property. However, few samples have been analyzed from the western portion of the site and the origin of cinders has not been determined.

An estimated 2.5 million gallons of leachate, ranging in thickness from three to ten feet, are present in the landfill (see Exhibit 6). In addition, a small area (220 square yards) in the southwestern area of the landfill contain six feet of leachate and fill. No water or leachate seeps have been observed along the eastern edge of the landfill. On-site soil is comprised of silty clays and clayey silts and ranges in thickness from 12 to 90 feet beneath the fill material. Liquid within the landfill has been observed in in portions of the landfill to be perched above the regional water table.

B. Data Collected in the LOU RI

As part of the RI for the LOU, respondents collected ten surface soil and cinder ("BS") samples from the northwestern, central and eastern portions of the site and analyzed these for volatile organic compounds ("volatiles"). A composit from surface cinder and soil samples was taken for semivolatile, inorganic, and total phenols analyses.

Fifteen test pits (TP1 through TP15 on Exhibit 4) were excavated to depths ranging from ten to 20 feet in the northern, central and eastern portions of the site and adjacent Turnpike and Conrail properties. In total, five solid samples and two aqueous samples were analyzed. Three of the 15 test pits were excavated from the Turnpike property; of these three test pits, one solid sample (TP2) was analyzed. Four of the 15 test pits were excavated from the Conrail property; solids from two test pits (TP10 and TP11) and leachate from one test pit (TP12) of these four pits were sampled. Six test pits were excavated on-site; solids and leachate from one on-site test pit (TP14) were sampled. Six test borings [B-1, B-2, B-2A, B-3, B-3A, B-4 (a background location)] were installed at four locations on-site, and samples were analyzed from depths ranging from three to 40 feet. These cinder and soil samples were analyzed for volatiles, semivolatile compounds, pesticides, PCBs, and metals (see Exhibit 4). Visual observations from each test pit and borehole, including observations of saturated conditions, were logged.

Two sediment samples ("SED-4" and "SED-5") and two water samples ("WA-4 and WA-5") were obtained from an area of former on-site ponded water. Three sediment samples ("SED 1, SED-2, and SED-3") were obtained from Frog Run. These five sediment samples were analyzed for volatiles, semi-volatiles, pesticides, PCBs, and metals.

Two surface water samples (WA-4 and WA-5) were obtained from an on-site area of ponded water (this "pond" no longer exists on the site, due to regrading). The two water samples were analyzed for volatiles. The samples were composited for metals analysis. These samples were not tested for semivolatile organic compounds.

Results and conclusions from these field activities in the "vadose zone" (the zone above ground water) are presented in Exhibits 7, 8, and 9 and are discussed below.

1. Surface soil, shallow cinders, and sediments

Toluene (a component of gasoline and diesel fuel) and 1,2-dichloroethane (a metal degreaser and paint remover) were detected in parts per million ("ppm") concentrations in the sediment samples from the former pond in the central portion of the site. Parts per billion ("ppb") levels of volatiles were detected in all other samples, except for tetrachloroethene ("PCE", a common solvent) which was detected in ppm levels at BS2.

Parts per million concentrations of 12 polycyclic aromatic hydrocarbons ("PAHs", which are semivolatile organic compounds commonly associated with fossil fuels) and bis(2-ethylhexyl)phthalate (a plasticizer) were detected in the shallow soil composit for the site. Six PAHs and three other semivolatiles [benzidine, (used in organic syntheses, manufacture of dyes and as stiffening agent in rubber compounding), bis(2-chloroethyl)ether (a solvent), and bis(2-ethylhexyl)phthalate] were found in ppm levels in sediment samples from the former ponded area. Because of the limited number and distribution of samples analyzed for semivolatiles, the distribution of the semivolatile contamination at the surface, for both soils and cinders, has not been determined.

Inorganic contaminants detected in the composit sample were comparable to levels detected in subsurface samples collected from the background test boring. However, concentrations of lead, chromium and copper were slightly elevated in one pond sediment sample in the central portion of the site.

Sample BS5, collected from the southeast corner of the site, was the only sample to show no detectable levels of either organic or inorganic contamination.

2. Cinder samples in landfill

Two subsurface samples of cinder fill were collected, from TP-2, in the central portion of the Turnpike property, and B-3A, near the former pond. Both samples detected priority pollutant compounds. However, constituents were different in the two samples.

The sample from TP-2 was collected from a deposit of cinder fill that was encountered below trash fill. This sample showed 330 ppb of ethylbenzene (an intermediate in production of styrene), 20 ppb of methylene chloride (a solvent and cleaning fluid), 130 ppb of toluene, 32 ppm of 2,6-dinitrotoluene, 69 ppm of hexachlorobenzene, 56 ppm of hexachlorobutadiene, and 26 ppm of bis(2-ethylhexyl)phthalate. The volatile compounds are similar in nature and concentration to contaminants found in other test pit samples composed of natural soils, and to contaminants detected in surface samples. Bis(2-ethylhexyl)phthalate, hexachlorobenzene, and hexachlorobutadiene were also detected at TP-14. Dinitrotoluene was not detected anywhere else on-site. PCB AROCHLORS 1248 (8.3 ppm) and 1254 (5.5 ppm) were also detected in TP-2. Again, this was the only location where PCBs were found.

Four PAHs, ranging in concentration from 100 ppb to 300 ppb, and 40 ppm of butylbenzyl phthalate (a plasticizer) were the only organic compounds identified in the cinder sample from B-3A. Parts per billion concentrations of ten methylated hydrocarbons were tentatively identified, possibly resulting from the degradation of a petroleum product.

Detected concentrations of the inorganic contaminants cadmium (39,600 ppm) and magnesium (13,600 ppm) were elevated above other test pit and test boring samples in the cinder sample from B-3A. While the cadmium level is notable, it appears to be an isolated occurrence within the existing database.

These samples are not considered to characterize the nature or distribution of contamination within the cinder fill. They can only be considered representative of the immediate area in which the sample was collected, as there is no consistency between the two samples.

3. Soil beneath landfill

In natural soils at the base of fill (test pits 5, 10, 11 and 14), ppm concentrations of four volatiles [ethylbenzene (a component of gasoline), toluene, trichloroethene ("TCE", a common solvent) and PCE] and 11 semivolatiles including bis(2-chloroethyl)ether were detected. In natural soils ten to 30 feet below the base of fill, only diethylphthalate was detected, at concentrations of ten to 20 ppb. It is not likely that the diethylphthalate sample is representative of soils at these depths, since phthalate esters are not very mobile in the environment and this was the only sample in the entire database to detect this particular compound.

Inorganic constituents were generally detected at background levels in natural soils above 10 feet. However, arsenic was found in ppm levels. Chlordane, detected in a concentration of 134 ppb in TP11, constitutes the only pesticide found in natural soils at the base of the fill.

The nature of contaminants detected at the base of the fill in test borings is different from those found in test pit samples.

4. Leachate samples from beneath fill

Saturated fill was encountered in seven test pits and two borings in the central and southcentral portions of the landfill. Only two test pits contained free standing water. Aqueous samples were taken from these two pits. Seven volatiles, 16 semivolatiles, and three pesticides were found in the two leachate samples. All concentrations in leachate were in ppb concentrations. TCE is quite mobile in the environment and therefore may be expected to be found in higher concentrations.

5. Ponded water samples

Six volatile compounds were detected, at similar concentrations, in each ponded water sample. Maximum concentrations of the volatile compounds detected include:

toluene– 844 ppb
trichlorfluoromethane - 368 ppb
1,1,1-trichloroethane - 6.8 ppb
ethyelbenzene - 2.6 ppb
benzene - 2.3 ppb
1,1-dichloroethane - 1.9 ppb

The following metals were detected in the composit sample, each in concentrations no greater than 0.4 ppb: antimony, arsenic, barium, chromium, copper, lead, selenium, and zinc.

6. Stream sediments

Arsenic (800 ug/kg), beryllium (400 ug/kg), and cadmium (1,610 ug/kg) were detected in stream sediments in concentrations higher than those found on-site. PAHs also were detected in stream sediments in high concentrations (up to 400). Although the site is expected to contribute to this contamination, upstream sources also may account for at least some of this contamination.

7. Underground tanks and pipes

Four underground storage tanks are located on-site. A 10,000-gallon diesel fuel tank and a 4,000-gallon diesel fuel tank were installed in 1986. An 8,000-gallon diesel fuel tank was installed approximately ten years ago. The age of a 1,000-gallon gasoline tank is unknown. Results from Horner Tank tests on the tanks installed prior to 1976 indicate leak rates less than (-.05) per hour, which meets National Fire Protection Association Code 30 criteria.

Three septic tanks are reported to connect to lavatory facilities. Floor drains, reportedly, do not drain into them. The presence or condition of leaching beds is unknown.

C. Potential Routes of Migration From LOU Sources and Ground Water Fate-and-Transport Assessment

One major route of migration of hazardous substances associated with the LOU includes transport through the subsoil and bedrock via infiltrating water. Once hazardous substances reach the ground water, they may or may not move at the same speed and in the same direction as ground water. Other potential routes of migration include transport to the stream via erosion and runoff, airborne transport from fugitive dusts, and volatilization.

As described in the "Analysis of Contaminated Distribution and Fate-and Transport at the Henderson Road Landfill Operable Unit", prepared by Camp Dresser and McKee and dated May 30, 1989, the overall mobility of organic contaminants in the natural silty clay soils on-site is considered moderately low. Organic compounds with relatively high soil:water partition coefficients, or "Koc", are considered relatively immobile in soil (see Exhibit 10). The chemicals found on-site that are considered to be more mobile (i.e., more likely to migrate from soil to ground water) are bis(2-chloroethyl)ether, benzene, PCE and TCE. Many of the PAHs, pesticides, and PCBs detected on-site are carcinogens and may migrate via airborne dusts. However, when bound to soils, they tend not to leach and not to be transported to ground water. Additional surface sampling is needed as part of the LOU RD to characterize surface sources of contamination and supplement RD planned as part of the IWOU.

D. Results and Conclusions from IWOU RI

The RI for the IWOU concluded that the waste disposed into the injection well has migrated to an area beyond the injection well's immediate environs. Gross and/or dissolved contamination is expected to exist in the void spaces and fractures in the bedrock in both the unsaturated and saturated zones.

As part of the RI for the IWOU, samples were collected from on and off-site wells and untreated and treated UMR water. A risk assessment was performed, using this data. Data from IWOU monitoring wells is not considered representative of ground water impacted from the LOU. Exhibits 11 and 12 summarize the human health risks for the 13 models assessed for the IWOU.

The carcinogenic risk for the IWOU, based on maximum concentrations of ground water sampled beneath the site, totals 3.6×10^{-2}. The Hazard Index, also based on maximum on-site concentrations of ground water, totals 386. Vinyl chloride (a degradation product of TCE and used as adhesive for plastic), 1,1-dichloroethane (a solvent and fumigant), and PCE were identified as posing the greatest proportion of the potential cancer risk associated with consumption of ground water beneath the site even though toluene and xylenes were found in greatest concentrations in ground water. 1,2-dichloropropane (a solvent, degreaser and soil fumigant) contributes the greatest proportion of noncarcinogenic risk at the site and UMR.

In untreated UMR water, TCE, 1,1,1-trichloroethane (a solvent), and carbon tetrachloride (formerly used as a metal degreaser, solvent and a refrigerant) were found in the highest concentrations. However, vinyl chloride, chloroform (used in flourocarbon refrigerants, plastics, and as a solvent), 1,2,3-trichloropropane (a solvent and degreasing agent) and dichlorobromomethane were identified as posing the greatest carcinogenic risk in untreated UMR water.

Treated UMR water meets Federal Safe Drinking Water Act requirements. The total risk from treated water was calculated at 4.4 x 10^{-5} (using maximum concentrations) and 1.9 x 10^{-5} (using averages).

Thirty-five chemicals of concern were identified in the IWOU RI (see Exhibit 15). Fifteen of the chemicals of concern associated with the IWOU were found at UMR in 1986. Certain site-related chemicals also have been detected between the site and UMR and at the McIlvain well.

The site is located in an area of regional ground water contamination. Two compounds, 1,1,2,2-tetrachloroethane and 1,2,3-trichloropropane, which contributed one-fifth to one-eighth of the risk associated with untreated UMR water in 1986, were not detected at the site in 1986. Trichloropropane accounts for the second highest proportion of carcinogenic risk in one model that was used in the IWOU Risk Assessment. Furthermore, five organic compounds have been detected in excess of health-based levels in four off-site wells not considered to presently be affected by the IWOU. Exhibit 14 shows other potential regional sources of contamination.

VI. LOU RISKS

A. Human Exposure pathways

1. Ground water exposure - One major human exposure pathway is inhalation and ingestion of ground water. To estimate the risk from the LOU via ground water exposure, maximum and mean values from the two leachate samples collected in the landfill were multiplied by 0.15 — a value used to represent dilution of leachate to the property line. For chemicals not detected in leachate but found in soil, a calculation, based on the organic carbon coefficient of the respective chemicals and the fraction of organic carbon in the soils on-site, was applied to predict the anticipated concentrations in ground water beneath the site. The 19 indicator chemicals and the concentrations used in this calculation are presented in Exhibit 13.

Based on the high rate of pumping at UMR and potentiometric surfaces, the IWOU RI concluded that on-site ground water eventually reaches UMR. Nine chemicals of concern for the LOU are also chemicals of concern for the IWOU*. The LOU Risk Assessment concludes that UMR also presents a potential exposure pathway.

*See Table 7-1 to IWOU ROD and Exhibit 13 to this ROD. Data collected from UMR is considered very limited, as many constituents found at the site are not typically tested by PSWC. UMR draws water from a large area where other potential sources also exist.

2. Exposure via dust and vapor inhalation - A second exposure pathway associated with the LOU is inhalation of dusts and vapors generated from heavy equipment by on-site workers and area residents. The concentrations of soil particulates and vapors both on and off-site were modelled in the LOU Risk Assessment with a two-step process. This process first estimated rates of emissions and then incorporated these rates into an air dispersion model.

3. Exposure with ingestion of soils and dermal contact - A third exposure pathway is ingestion or absorption via dermal contact of soils by on-site workers during daily activities and by trespassers. For on-site workers, an incidental soil ingestion and dermal contact rate of 100 mg/day was adjusted for five working days per week, 50 weeks per year, and 30 years per lifetime. Trespassers on the site were assumed to be children (30 kg) who would visit the site 30 times per year and ingest or contact 100 mg of soil per visit for five years of a 70-year lifetime. Absorption through dermal contact was not included directly in the risk calculations but was assumed to be included in the risk from incidental ingestion of soil.

B. LOU Human Health Risk Assessment

The population at risk from the LOU is limited to potential ground water users, on-site workers and potential trespassers. No residential wells were identified in the IWOU RI as affected by the site. However, several wells in the vicinity of the site are used by local businesses and industries. The IWOU RI identifies the McIvain well as presently affected by the site. Finally, customers served from UMR also are potentially affected by the LOU. The IWOU RI and ROD address the risk assessment performed on both the McIlvain well and UMR.

Exhibit 16 summarizes the baseline risk for the LOU. The total upper-bound excess lifetime carcinogenic risk to a maximally exposed individual for the LOU is estimated at 1 x 10^{-2}. The primary risk associated with the LOU, 8.4 x 10^{-3}, using maximum values, is from potential exposure to ground water predicted to be contaminated from transport of hazardous substances through the fill material, natural soils, and bedrock fractures and voids. The Hazard Index totals 3.9 (using maximums) for ground water. The next highest risk pathway for carcinogens, 1.5 X 10^{-3} (maximum values), is for incidental ingestion of soil by on-site workers. In addition, a maximally exposed on-site worker would have an upper-bound excess lifetime risk of 2.4 X 10^{-4} via inhalation of fugitive dusts and vapors, based on maximum concentrations. In general, non-carcinogenic risk totals reflect a similar ranked order as for carcinogens. The Hazard Index totals less than one for ingestion of soil and inhalation of fugitive dusts and vapors.

PAHs comprise 60 percent of the ground water risk calculated in the RI and are the most prevalent hazardous substances found in the LOU. According to the ground water risk assessment, aldrin and PCBs comprise an additional 17 and ten percent of the carcinogenic risk, respectively. However, PAHs, aldrin and PCBs tend to remain bound to soils and not be transported to ground water. Bis(2-chloroethyl)ether and six volatiles — benzene, chloroform, PCE, TCE, 1,3-dichloropropene, and hexachlorobenzene — are considered relatively mobile (See "Analysis of Contaminated Distribution and Fate-and-Transport at the Henderson Road Landfill Operable Unit," prepared by Camp Dresser & McKee and dated May 30, 1989). EPA considers existence of these chemicals in landfill leachate to pose the greatest threat to ground water. EPA attributes about three quarters of the risk of cancer from ground water exposure to bis(2-chloroethyl)ether and the remaining one quarter of ground water carcinogenic risk to the six volatile organics listed above.

Aldrin constitutes 72 percent of the maxiumum Hazard Index of 3.9 for non-carcinogenic risk associated with ground water. Since aldrin is not considered mobile, 1,3-dichloropropene, which accounts for 8 percent of the maximum noncarcinogenic risk, is the major noncarcinogenic chemical of concern associated with use of on-site ground water.

The next highest risk pathway for carcinogens is ingestion of soil by on-site workers. Benzidine, found in only one sample, represents 47 percent of the risk and PAHs represent another 47 percent. The Hazard Index for ingestion or direct contact of on-site workers with soils is due primarily to lead.

The carcinogenic risk via inhalation is dominated by chromium (75 percent of maximum). Benzidine represents 15 percent of the maximum carcinogenic risk via inhalation but was found in only one sample. The Hazard Index for on-site workers is due primarily to inhalation of barium.

C. LOU and IWOU: Comparison of Human Health Risk Assessments

The chemicals of concern proposed in the draft FS and adopted in this ROD were based on chemicals use in the Risk Assessment. The Fate-and-Transport Assessment was not directly factored into selection of chemicals of concern.

About half of the chemicals of concern associated with the LOU and adjacent properties also are identified as chemicals of concern for the IWOU. Benzene, which is a compound identified in the IWOU ROD as a potential "regional contaminant", is associated with the predominant risk for both operable units. However, the other chemicals comprising the predominant carcinogenic risk identified at present for the two operable units are different. Data from additional monitoring wells, to be installed for both the IWOU and proposed for the LOU, is expected to support a more thorough characterization of the ground water for both operable units and enable risk predictions to be refined.

The risk assessment for the IWOU only addressed ground water risks. The upper-bound excess lifetime carcinogenic risk to a maximally exposed individual calculated for the IWOU, based on actual ground water data, was calculated at 3.6×10^{-2}. The predominant carcinogenic risk for the LOU,

8.4×10^{-3}, was based on prediction of movement of leachate to ground water. An additional carcinogenic risk, totalling 1.5×10^{-3}, is attributed to exposure from ingestion of soil and inhalation of fugitive emissions in the LOU Risk Assessment.

The universe and volumes of materials disposed neither via the injection well nor from the LOU have been reported to the EPA. The local direction of contaminant movement in the fractured bedrock and ground water also is not known. Contamination from the IWOU may affect ground water also impacted or potentially impacted from the LOU. Thus, EPA does not expect to distinguish the sources or relative risks of ground water contamination at or near the site between the two operable units.

Substantial uncertainties are associated with the characterization of both operable units. In light of these uncertainties and EPA's general standard for clean-up of Superfund sites to the 10^{-4} to 10^{-6} risk level, the potential for adverse health effects, based on carcinogenic risks, is considered substantial. "No action", with a risk estimated at 1×10^{-2} for the LOU, is unacceptable and site remediation to within the 10^{-4} to 10^{-7} risk range or background levels is recommended as an initial remedial objective.

D. Environmental Risks

The principal chemicals of concern associated with Frog Run are those bound to soils. The levels of dissolved chemicals are within a factor of ten of the aquatic chronic criteria; the RI concluded it is not likely that these concentrations represent a threat to any continuously flowing stream of the Schuylkill River. Semivolatile chemicals such as PAHs associated with site soils can reach viable habitats via the gradual movement of sedimentary material along the stream bed. These semivolatile chemicals represent a potential for impact via bioconcentration. However, concentrations of PAHs in upgradient and downgradient samples are similar, suggesting that off-site contributions of PAHs mask any contribution from the site.

VII. DESCRIPTION OF THE ALTERNATIVES

A. Remedial Objectives

The respondents developed seven remedial alternatives in the FS, based on the remedial objectives summarized below:

- reduce the risk for ground water, soil, fill materials, leachate, and air to an acceptable level for carcinogens and noncarcinogens;

- restore the aquifer beneath the site to "Class IIA" classification;

- prevent significant transport/migration of contaminants in soil, fill, and leachate to ground water;

- prevent the generation of leachate and thereby prevent the release of contaminants to ground water;
- significantly reduce the potential for release of site contaminants to the environment through fugitive particulate or vapor emissions.

Inherent in many of these remedial objectives are "applicable or relevant and appropriate requirements ("ARARs"). ARARs may include:

- any standard, requirement, criterion, or limitation promulgated under Federal environmental law;
- any promulgated standard, requirement, criteria, or limitation under a state environmental or facility-siting law that is more stingent than associated Federal standards, requirements, criteria, or limitations.

ARARs may be contaminant-specific, location-specific, or action-specific. Exhibit 17 summarizes the ARARs considered in the FS for the LOU. Additionally, Federal Underground Unjection Well requirements may be applicable or relevant and appropriate, as may ground water withdrawal and discharge requirements which are under the jurisdiction of the Delaware River Basin Commission.

EPA developed an eighth alternative, based on Alternatives 3 and 7 described in the draft FS and the remedial objectives listed above, but also considering the following:

- the need to fully coordinate ground water recovery, characterization and remediation in the western portion of the site, and monitoring with the IWOU;
- Pennsylvania Turnpike Commission plans to expand the Turnpike in the vicinity of the site to six lanes;
- the need to remove obvious high levels of contamination that may be encountered, such as highly stained soils or containerized waste, prior to capping.
- a potential conflict in maintaining the PSWC water line on-site with remedial objectives and State ARARs.

Alternative 8 is presented in this ROD but not included in the draft FS.

B. Summary of Alternatives

The seven alternatives evaluated in the FS and EPA's selected alternative, Alternative 8, are summarized below.

1. Alternative 1

This alternative would require no on-site remedial activities. The site would be fenced, periodic monitoring of surface water, vadose zone, and ground water contaminants would be conducted, and deed restrictions would be instituted to limit future uses of the site and affected properties.

Surface water monitoring would identify the extent, if any, to which Frog Run is affected by remedial action. Surface water would be sampled two times per year following rain events at three stream locations. Data from vadose zone monitoring would provide warning prior to an additional release to ground water.

If significant soil moisture is consistently detected, engineering improvements would be considered. Ground water monitoring would identify changes in ground water quality even though it may not be possible to identify whether a particular ground water change is due to the LOU, IWOU, or off-site sources. The ground water monitoring program is described in Alternative 7.

Under this alternative, approximately 125,000 cubic yards of trash, approximately 33,000 cubic yards of cinder fill, an undetermined amount of deeper contaminated soils and bedrock, and 2.5 million gallons of leachate would remain on-site and on adjacent properties. Additional leachate would be generated in the future, posing a further threat to ground water. Without capping, Alternative 1 would be unlikely to meet state closure requirements.

This alternative would not reduce the existing risk from exposure to vapors and dusts. The risk associated with this alternative, 1×10^{-2}, primarily based on the prediction of the movement of leachate to ground water, would exceed EPA's range of acceptability.

Estimated Construction Cost:	$ 325,500
Estimated Annual O&M Costs:	$ 72,500
Total Present Worth:	$1,077,100

Estimated Implementation Timeframe: Three months to implement.

2. Alternative 2

In this alternative, the existing on-site corrugated metal storm sewer line would be replaced with HDPE pipe and the site would be graded to proper contours. Either a RCRA multi-layer cap or a PA Solid Waste multi-layer cap would be installed over the landfill. Areas not already paved in the western portion of the site would be covered with bituminous (asphalt) cap. Surface water, ground water, and landfill gas would be monitored, and institutional controls would be implemented to limit future uses of the site and adjacent properties.

Regrading, improved surface drainage, and capping would facilitate runoff into the storm sewer, reduce infiltration of water into the landfill, and thus reduce the production of leachate and associated risks. Furthermore, capping would address the risk from direct contact and inhalation of fugitive dusts for the duration of the O&M. Replacement of the existing storm sewer line would eliminate the possibility of leakage through the corrugated metal pipe joints under the cap.

Four inlets would be constructed to provide drainage for the completed cap. Two-foot by two-foot passive gas collection trenches would be dug into the top of the fill just inside the perimeter of the cap and filled with two-inch stone. Vent pipes would penetrate the cap to release gases from the trenches. In addition, piezometers would be installed in and around the landfill to monitor the vadose zone.

Alternative 2 includes installation of a RCRA or PA Solid Waste cap to cover the central and eastern portions of the site and affected Turnpike Commission and Conrail properties. A RCRA cap would use both a synthetic membrane and a compacted clay layer as barriers. The PA cap would include a single compacted clay layer. Synthetic membranes provide the lowest permeability barrier when properly installed and maintained. Compacted clay also provides a very low permeability barrier and is "self-mending" when small cracks form with age. On the east side of the landfill, steeper slopes may require only a clay cap to assure cover slope stability. This would be further addressed during RD.

As with Alternative 1, existing trash, cinders, contaminated soils and bedrock, and leachate would remain on-site. However, based on a minimum of one gallon of leachate generated per acre per day with a cap, future leachate to be generated would be reduced from an estimated 3.4 million gallons per year to less than 3,000 gallons per year. Consequently the ground water risk would be reduced by three orders of magnitude. The risk from air exposure would be eliminated for the duration of O&M. Using this approach, the risk associated with Alternative 2 is estimated at 8×10^{-6}. Because this alternative does not include collection of leachate — the medium considered to pose the greatest proportion of risk — this alternative may not meet State ARARs for closure.

Estimated Construction Cost:	\$2,469,000 (RCRA cap) 1,745,000 (PA cap)
Estimated Annual O&M Costs:	\$ 91,700
Total Present Worth:	\$3,420,000 (RCRA cap) 2,696,000 (PA cap)

Estimated Completion Timeframe: Six months to implement.

3. Alternative 3

As in Alternative 2, Alternative 3 would include regrading the landfill and capping it with either a RCRA or PA Solid Waste multi-layer cap. A bituminous cap would cover areas not already paved in the western portion of the site. Institutional controls would be implemented as in previous alternatives. Alternative 3, however, includes installation of a french drain and sump leachate collection system in the landfill along with monitoring and off-site treatment of leachate.

As with Alternatives 1 and 2, existing trash, cinders, and contaminated soils would remain on-site. The effect of an asphalt cap over the western portion of the site is unknown because EPA has determined that this portion of the site is inadequately characterized. The draft FS does not identify drainage controls to be instituted in this area, nor are maintenance measures described or costed out. However, removal and treatment of leachate — the medium posing the greatest risk — would reduce the carcinogenic risk identified under Alternative 2 by one-half, resulting in a total carcinogenic risk of 4×10^{-6}. 2.5 million gallons of existing leachate and 3,000 gallons of leachate estimated to otherwise be generated each year would be directly treated.

Leachate treatment and disposal options include:

- on-site leachate treatment in conjunction with the ground water treatment system to be constructed as part of the IWOU remedial action. The treatment system to be designed for the IWOU is planned to involve metals precipitation and air stripping. This system may be suitable to treat landfill leachate, although additional physical, chemical, or biological treatment may be needed to remove semivolatiles or increase treatment efficiency. Treated water would be disposed either into the local sewer system or adjacent stream; some of the treated water may be reinjected to the aquifer or distributed to PSWC;

- off-site disposal of collected leachate for treatment at the local sewage treatment plant. Pretreatment may be needed;

- disposal of collected leachate at an off-site commercial facility.

ARARs listed in Exhibit 17 include those for leachate treatment. Although off-site treatment and disposal are included in this alternative for costing purposes, the final treatment and disposal option would be selected during RD. Performance standards for leachate treatment would be based on the disposal option selected. Leachate will be monitored and treated for chemicals of concern listed in Exhibit 15. Should additional constituents be identified in the leachate during RD/RA, treatment and monitoring may be enhanced accordingly.

In general, Aternative 3, with capping, leachate collection, and monitoring, is expected to meet State landfill closure requirements.

Estimated Construction Cost: $3,196,000 (RCRA cap)
$2,472,000 (PA cap)

Estimated Annual O&M Costs: $ 96,700

Total Present Worth: $4,199,000 (RCRA cap)
$3,475,000 (PA cap)

Estimated Completion Timeframe: Ten months to implement.

4. Alternative 4

As in Alternative 3, Alternative 4 would include run-on, run-off and erosion controls, either a RCRA or PA Solid Waste Cap, leachate monitoring, collection, and treatment, surface water, landfill gas, and vadose zone monitoring, property agreements, and deed restrictions. Areas not already paved in the western portion of the site would be covered with asphalt, as in Alternative 2.

Alternative 4 also would use an active gas recovery system to remove volatile organic compounds in the landfill through "in-situ volatilization". In-situ volatilization would consist of a series of gas recovery wells placed within the fill material and connected to suction blowers equipped with carbon adsorption treatment units. The number of collection wells, size of the blowers, and capacity of the carbon treatment units would be determined during RD and be based on pilot testing.

In-situ volatilization may remove volatile organics in the trash. Less volatile organics and inorganics would not be removed in the trash. Also, volatiles absorbed to clays or cinders beneath the fill would not be likely to be removed with this technology.

Records identifying the volume, chemical characteristics, and location of wastes disposed onto the LOU have not been provided to EPA. The varied composition of in trash, cinders, and soils beneath the fill precludes estimation of total volatiles in the LOU. Consequently, the volume of volatiles to be recovered with in-situ volatilization has not been identified. Similarly, the volume of nonvolatiles that would be left in place in the trash and the volume of volatiles and nonvolatiles that would be left in place in the soil and cinders beneath the fill have not been identified.

The draft FS states that in-situ volatilization would be terminated once volatile organic compounds are removed to clean-up levels that would be determined in RD. The draft FS further states that ARARs may be exceeded with this technology. However, EPA anticipates that a very low efficiency of volatile organic removal is likely to be achieved with in-situ volatilization because the concentrations of volatiles in the landfill are low compared to the concentrations of these compounds at other sites where in-situ volatilization has been successful. Thus, it is unlikely that ARARs would be exceeded.

Additionally, in-situ volatilization would not address bis(2-chloroethyl)ether, which is not very volatile. Bis(2-chloroethyl)ether comprises about three quarters of the risk to ground water.

Assuming in-situ volatilization removes 100 percent of the volatiles in the LOU, as represented by maximum values used in the Risk Assessment, the risk to ground water quantified under Alternative 3 would be reduced by an additional on-quarter, and result in an upper-bound lifetime risk to a maximallly exposed individual of 3×10^{-6}. Thus, many wastes comprising most of the risk, including volatile organic compounds and bis(2-chloroethyl)ether, would still be left in place.

Estimated Construction Cost: $4,526,000 (RCRA cap)
$3,802,000 (PA cap)

Estimated Annual O&M Costs: Yrs 1-3 $759,000
Yrs 4-30 $95,700

Total Present Worth: $7,332,000 (RCRA cap)
$6,609,000 (PA cap)

Estimated Implementation Timeframe: 11 months to implement.

5. Alternative 5

This alternative includes dewatering and excavating "hot spots" in the landfill, estimated for costing purposes at 3,800 cubic yards, and either off-site incineration and off-site landfill disposal or offsite land disposal only. Overlying fill would be redeposited into the excavation and the landfill would be regraded and capped with a PA Solid Waste cap. The cinder fill on the western portion of the site which is not already paved would be covered with asphalt as in Alternative 2. Ground water, surface water, and landfill gases would be monitored to evaluate the effectiveness of Alternative 5. Institutional controls would be implemented to restrict future use of the site and affected properties.

The area assumed to be excavated is a contaminated area near the southcentral portion of the site near test pit 14. This area is identified in the draft FS as containing the highest concentrations of volatile and semivolatile compounds. The horizontal extent of this area is not locally defined by the data available from the RI and the limits of this partial excavation would be determined in the field during the remedial phase.

Approximately 4,000 cubic yards of fill material overlying the contaminated soils would be removed first and staged adjacent to the excavation. If necessary, the area would be dewatered to allow excavation to proceed more easily. If incineration is chosen, the underlying contaminated fill and soils would then be excavated and sorted to remove non-processable wastes such as large timbers, concrete, and wire. The sorted waste would be packaged in fiber drums and transported to an off-site hazardous waste incinerator. The non-processable waste would be loaded into trucks or roll-off boxes for transportation to a hazardous waste landfill. If no treatment is chosen, the contaminated soils and fill would be transported to an off-site hazardous waste landfill disposal facility.

Approximately 149,200 cubic yards of trash, fill, and cinders would still be left in place under Alternative 5. Deeper contaminated soils and bedrock also would be left in place. Finally, leachate outside the area to be excavated and/or to be generated in the future would not be collected.

Partial excavation, incineration, and land disposal are estimated to result in generation of leachate in volumes and concentrations slightly less than Alternative 2. Using these assumptions, Alternative 5 would result in a risk of less than 8×10^{-6}. Exposure and the consequent risk from airborne soils would be eliminated over the long-term.

The soil "clean-up" standards proposed for this alternative in the draft FS are not considered by EPA to be adequately justified. Since Alternative 5 was not selected for the remedy, "soil ARARs" are not presented in this discussion.

Excavated materials would need to be treated prior to off-site disposal in order to meet RCRA "Land Ban" requirements. Thus, treatment and incineration is the only subalternative that would meet Land Ban requirements. However, without leachate collection, Alternative 5 may not meet PA ARARs for closure.

Estimated Construction Cost: $11,670,000 (off-site incineration and landfilling)
$ 4,745,000 (off-site disposal only)

Estimated Annual O&M Cost: $ 91,700

Total Present Worth: $12,621,000 (off-site incineration and landfilling)
$ 5,696,000 (off-site disposal only)

Estimated Implementation Timeframe: 12 months to implement.

6. Alternative 6

Under this alternative, fill materials and contaminated soils in the leachate-saturated, central portion of the landfill, estimated to total 50,000 cubic yards, would be removed. Fill material overlying the contaminated soils (about 64,000 cubic yards) would be removed first and staged adjacent to the excavation. If necessary, the excavation area would be dewatered to allow overlying surface wastes to be removed more easily. The excavated, leachate-saturated fill and soil would be disposed by either off-site incineration and off-site land disposal or by off-site land disposal only. The overlying fill material would be consolidated into a smaller area of the site, estimated to cover 3.5 acres, capped with a PA Solid Waste cap, and vented with a passive gas venting system. The remaining excavated area would be filled with common soil. Monitoring would be conducted and institutional controls would be implemented as in Alternative 2.

If incineration was to be selected, the underlying contaminated fill and soils would be excavated and sorted to remove nonprocessable wastes such as large timbers, concrete, and wire. The sorted wastes would be packaged in fiber drums and transported to an off-site hazardous waste landfill. If incineration was not to be selected, all contaminated materials would be sent to an off-site hazardous waste land disposal facility. Under both options the existing storm sewer pipe would be replaced.

Excavation of leachate-contaminated fill and soils is included under this alternative because leachate is considered to present the greatest threat to ground water. 103,000 cubic yards of trash, fill, cinders and shallow soils, an unidentified volume of contaminated deeper soils and bedrock, plus 3,000 gallons of leachate estimated to be generated per year would not be removed under this alternative.

The risk associated with Alternative 6 is similar to that for Alternatives 2 and 5 because the same volumes of leachate would be generated under all three alternatives. EPA estimates that the risk would be somewhat lower than Alternative 5 (8×10^{-6}), however, since less contamination would be left in place. Also, State requirements for closure may require leachate collection.

Excavated materials would need to be treated prior to off-site disposal in order to comply with Land Ban regulations. Thus, the excavation and incineration subalternative is the only subalternative that meets Land Ban requirements. Even this subalternative may not meet air quality and water quality ARARs in the short term, because dusts and odors would be generated during excavation, possibly in exceedence of National Ambient Air Quality Standards and Pennsylvania Air Pollution Control regulations.

Estimated Construction Cost:	$131,137,000 (off-site incineration and off-site disposal) $ 37,365,000 (off-site disposal only)
Estimated Annual O&M Cost:	$ 91,700
Total Present Worth:	$132,087,000 (off-site incineration and off -site disposal) $ 38,316,000 (off-site disposal only)

Estimated Implementation Timeframe: 18 months to implement.

Alternative 6 is from three to 50 times more expensive than Alternatives 1 through 5.

7. Alternative 7

The respondents present Alternative 7 in the FS as a contingent alternative to be implemented if the LOU contributes to ground water contamination*. The respondents propose instituting ground water pumping and treatment if ground water remediation is indicated for the LOU after the ground water recovery system for the IWOU is operated. This remediation would supplement the ground water pumping and treatment planned for the IWOU.

Ground water pumping, if successful, would remove contaminated water from the aquifer and keep contaminated ground water from leaving the site. As part of IWOU Remedial Action, sufficient wells will be installed in the most productive fractures or solution features to recover contaminated ground water beneath the site. Initially, three to five 8-inch ground water recovery wells, each installed to a depth of up to approximately 400 feet, will be utilized to contain and collect the ground water beneath the site. These wells are proposed to be pumped at a combined rate of about 300 gallons per minute. If contaminated ground water is found to be bypassing the collection system (as determined through perimeter ground water monitoring), additional recovery wells will be installed and/or the pumping rates will be adjusted to create a suitable area of pumping influence.

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*Criteria for ground water pumping are different in EPA's selected remedy than in Alternative 7, as presented in the draft FS.

The IWOU treatment system will be based primarily on use of an air stripper. Air stripping technology is based on the principle of vapor-liquid equilibrium. Contaminated water is contacted with large volumes of ambient air. The concentration of contaminants in the influent air is far below equilibrium, providing the driving force for transfer of contaminants from water to air. Contaminated water is pumped from the water source to the tower, where it is countercurrently contacted with air. The water entering the tower trickles down over a packed media which generates a thin film of water for air contact. The thin film provides a large surface area for air to water contact. Air stripping has been demonstrated to provide a cost-effective system for removing volatile organics from ground water.

Exhibit 21 outlines possible treatment processes to be used on ground water to be pumped at the IWOU. Additional treatment could include pH adjustment, granular activated carbon, PACT activated sludge process, and filtration. If required to meet air pollution control requirements, the effluent from the air stripper will flow through a dehumidifier and a vapor phase carbon adsorption unit to reduce emissions of volatile organic compounds (and/or leachate) to mandated levels. This system also may be used to treat ground water contaminated by the LOU. If additional treatment is needed to address contaminants that may be attributed to the LOU, these or other additional treatment components would be added to the IWOU treatment system.*

The Delaware River Basin Commission reviews all permit applications for ground water withdrawals exceeding 10,000 gallons per day (gpd). Performance standards for the ground water treatment system will be based on the option, to be selected during IWOU RD, for disposal of treated ground water. Exhibit 17 includes water and air quality ARARs with which the treatment system must comply.

Estimated Construction Cost:	$ 444,600
Estimated O&M Cost:	$ 104,000
Total Present Worth:	$1,523,000
Estimated Implementation Timeframe:	Two years to begin pumping (not clearly indicated in FS).

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*Since all materials injected into the injection well and/or disposed into the landfill operable unit have not been identified, it is unlikely that ground water contaminants soley attributed to either operable unit may be identified.

8. Alternative 8

(a) Summary of Components of Alternative 8 - Alternative 8, developed by EPA, includes:

- Alternative 3 - regrading, collection of runoff, runon and erosion controls, leachate collection and treatment, capping* monitoring, and institutional controls on-site and on adjacent properties to restrict activities that would interfere with remediation at the site (see Exhibit 19);
- Alternative 7 - contingent ground water recovery and treatment. A determination to institute pumping would be based on detection of site-related ground water contamination at or near the property line and a determination that ground water is still leaving the site after two years of ground water pumping for the IWOU (see Exhibit 20).**
- Movement of trash, shallow soils and shallow cinder fill from the Turnpike property to the Henderson Road site, additional characterization of the Turnpike property after excavation, and appropriate remediation to address wastes left in place and existing and potential leachate there;

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* See discussion below. A PA Solid waste cap is included in Alternative 8 for the central and eastern portions of the site. This alternative includes consolidating characterization and evaluation of remedial alternatives for the western portion of the LOU with RD/RA for the IWOU and deferring selection of the remedy for the western portion of the LOU which may include an asphalt or PA Solid Waste cap, until that characterization work is complete. Furthermore, the means of preventing generation of leachate, including technologies to prevent infiltration and leachate collection and treatment under the Turnpike property, is proposed under this alternative to be determined during RD.

**The Consent Decree for the IWOU requires ground water pumping to address ground water contamination attributed to "the site". See Section V.B. of the Consent Decree and Section 2.6.1 to SOW. The "two years of ground water pumping for the IWOU" is specified for additional LOU ground water recovery as part of this ROD simply to coordinate LOU pumping with the Final O&M Phase Plan for the IWOU. As described in Section 2.6.1 of the IWOU SOW, "if contaminated ground water is found to be bypassing the collection system (as determined through perimeter ground water monitoring), additional recovery wells will be installed and/or pumping reates will be adjusted to create a suitable cone of depression." Thus, ground water pumping beneath or downgradient from the LOU may commence during RD for the IWOU if the above criteria are met. Remedial objectives to contain site-related ground water overlap for both operable units.

- Removal of surface oil-contaminated soils, containerized hazardous wastes, or highly contaminated soils, if encountered;
- An expanded monitoring program over that recommended in the FS and biannual evaluation of data and remediation performance;
- Coordination with IWOU RD/RA in ground water pumping and monitoring, characterizing and evaluating the western portion of the site, evaluating and reporting on LOU RD/RA performance, and determining over the long-term when and whether remedial objectives are met.

(b) Description of Components of Alternative 8 - As part of Alternative 8, a short-term leachate collection program would be designed and implemented to initially remove existing leachate from the central and eastern portions of the LOU, including the Turnpike and Conrail properties. This initial leachate collection is expected to reduce the transport of contaminants in existing leachate to ground water and thereby significantly reduce the risk. The initial leachate collection program would be immediately followed with a long-term leachate collection program, using french drains. The locations of these drains would be identified during RD. Potential lateral infiltration of water on-site from the Turnpike property or from other off-site locations would be addressed in RD.

As described under Alternative 3, leachate may be treated either on-site with collected ground water, at the local sewage treatment plant, or at an off-site commercial treatment facility. The leachate treatment and disposal option, to be selected during RD, will determine respective performance standards. Exhibit 17 includes potential ARARs for leachate treatment.

Alternative 8 includes a PA Solid Waste cap. This type of cap would provide the same degree of containment as a RCRA cap but for less cost. The PA cap would extend over the eastern and central portions of the site up to the Turnpike property, and include contaminated portions of the adjacent Conrail property to the south. The cap would be designed to address potential lateral migration of leachate into the capped area from off-site areas, including the Turnpike property. Since the Turnpike property will be excavated in order to accomodate Turnpike expansion, the PA cap was assumed, for costing purposes, to not be needed over that adjacent area to the site.

Leakage of the water main which runs through the eastern portion of the site would interfere with remedial objectives. Alternative 8 includes addressing potential leakage during RD. Some options under consideration include:

(1) excavation of contamination in vicinity of the pipe, runon/runoff controls, encapsulation of the pipe with cement and leak detection monitoring;

(2) moving the pipe further east of the site;

(3) moving the pipe from the northeast corner of the site to Henderson Road and along the western perimeter of the site.

Option 2, estimated to cost about $1.5 million, is used for costing purposes. Option 1 is expected to be significantly less costly than option 2 and Option 3 is expected to cost $2.5 million. Only if remedial objectives and concerns raised by PA DER (see Responsiveness Summary) are met would an alternative to moving the water main be accepted.

In the draft FS, the respondents propose bituminous paving over the western portion of the site. Alternative 8 includes characterization of contamination sources in the western portion of the site attributed to the LOU — i.e., surface sources of contamination and hazardous substances expected to be associated with cinders — as a supplement to the additional characterization planned for the vadose zone for the IWOU RD/RA. During this characterization, the three septic tanks and the floor drains in this area would be remediated. "General Scope of Work to Characterize the Cinder Fill in the Western Portion of the Henderson Road Landfill Operable Unit," prepared by Camp Dresser and McKee and dated July 7, 1989, describes work to be performed as part of this additional characterization of the western portion of the site. A Fate-and-Transport Assessment, Risk Assessment, and Focused Feasibility Study, or equivalents of these studies, would be developed under Alternative 8 as part of RD/RA for the LOU in coordination with RD/RA for the IWOU to address the cinders, soils, and unsaturated zone in the western portion of the site. After the Focused Feasibility Study (or equivalent) is completed, EPA would select a remedy to address remediation in the western portion of the site. This remedy would be part of both operable units. Alternatives to evaluate in the Focused Feasibility Study may include, among others, in-situ volatilization, soil flushing (see IWOU ROD), and various kinds of capping.

Institutional controls, such as deed restrictions and easements, are included in Alternative 8 to restrict any activities on-site, on the Conrail property, or on other property(ies) that would interfere with the remedy. Any activities that would jeopardize the integrity of the cap, such as truck movement on the cap, or interfere with the leachate collection system would be prohibited. Access agreements would be established where recovery and/or monitoring wells are to be installed or operated and on the Conrail property, where the cap and the leachate collection system are expected to be extended. Appropriate institutional controls also would be implemented at other affected properties. These properties will be identified in RD.

The Consent Decree for the IWOU requires ground water pumping to address ground water contamination attributed to "the site". The IWOU SOW proposes an approach to siting on-site recovery wells in locations anticipated to address contamination most likely to be attributed to the injection well. As described in this ROD under Alternative 7 and stated in the IWOU SOW, if contaminated is found to be bypassing the collection system, additional recovery wells will be installed and/or pumping rates will be adjusted to create a suitable cone of depression. At least some of the contaminated ground water beneath the LOU may be contained on-site through the initial ground water pumping and treatment planned for the IWOU. However, since ground water may be affected by both operable units and records are not available to distinguish contaminants originating from either the IWOU or LOU, the criteria for initiating ground water recovery proposed under Alternative 7, i.e., "if the LOU contributes to ground water contamination", is infeasible.

Alternative 8 includes installation of LOU monitoring wells early in RD and initiation of additional ground water recovery for the LOU if:

- requirements for clean-up of ground water are exceeded at or near the facility boundary, and
- ground water is still leaving the site after IWOU recovery wells are operating.

These criteria are essentially the same as that for additional on-site ground water pumping associated with the IWOU.

To the maximum extent practical, technically justified and cost-effective, ground water recovery and monitoring wells will be situated on-site. However, recovery wells may be located off-site, such as on the Turnpike or PSWC properties, if such locations are determined to be optimum for preventing an additional downgradient release. This criteria is consistent with the criteria for off-site pumping described in Section 3.1 of the IWOU SOW.*

*Section 3.1 of the IWOU states:

The following criteria will serve as a basis to determine whether off-site pumping is warranted:

1. If it is determined that the area north of the Turnpike is optional for controlling further off-site release of contaminated ground water.
2. If data from off-site monitoring wells indicate that off-site, downgradient ground water contamination is similar in concentration and chemical composition to that detected on-site (near source)."

The draft Feasibility Study does not clearly indicate when a determination would be made to initiate and/or enhance ground water recovery for the LOU. Under Alternative 8, a preliminary recommendation would be made after LOU ground water monitoring wells are installed and sampled as part of or as a supplement to the Unsaturated and Saturated Zone(s) Investigation Report(s), to be submitted under the IWOU Consent Decree, and as a final recommendation in the IWOU Design and Construction Phases Plan or as a supplement to the Design and Construction Phases Plan, should combined recommendations for initiation of ground water recovery for both operable units cause a delay in the IWOU RD/RA. Furthermore, the performance of ground water recovery activities would be evaluated and recommendations to improve or enhance performance of the LOU remedy would be proposed on a biannual basis in synchrony with or as a supplement to the O&M Biannual Evaluation Reports. The function and contents of the above plans and reports are described in the SOW attached to the IWOU RD/RA Consent Decree. Improvements and enhancements to LOU remediation would be determined along with the EPA Five-Year Evaluation for the IWOU. Such coordination of RD/RA for both operable units will ensure that the remedy for the site will be implemented and evaluated in the most technically sound and cost-effective manner.

The Turnpike property is of particular concern because :

- State records indicate liquids may have been poured onto former trenches located there (See Administrative Record for LOU);
- only one test pit was sampled on the Turnpike property (several were excavated and logged there);
- the Turnpike Commission has expressed an interest in expanding the Turnpike to six lanes — an option that is expected to require particular attention during RD so that Turnpike expansion does not interfere with EPA's remedial objectives.

Alternative 8 includes excavation of trash and shallow soils and cinders on the Turnpike property, disposal of excavated material on to the Henderson Road sit , post excavation soil sampling, and backfilling the Turnpike property to accomodate future Turnpike Commission expansion plans. This alternative also includes, for costing purposes, implementing runon/runoff controls, leachate collection, and construction of an asphalt cap over 33,000 square feet of the Turnpike property. Additional remedial measures on the Turnpike property may be selected during RD if the additional characterization there indicates additional remediation is need to prevent a release of contaminants to ground water. To the maximum extent feasible and costeffective, ground water and leachate would be recovered and monitoring activities would be conducted off the Turnpike property in order to prevent a conflict between Turnpike expansion activities and remedial efforts.

Although sampling on the Turnpike property has been limited, EPA expects that contamination of the less mobile compounds, such as bis(2-chloroethyl) ether, aldrin, and PAHs, will be most prevalent in the upper three-to-five feet of soils and cinders. Volatiles may already have moved deep into the fractured bedrock and aquifer. Leachate, if encountered in the shallow zone, constitutes the major media of concern, since contaminants are expected to be transported to ground water primarily in leachate. Immediate collection of leachate, if encountered, and removal of shallow soils and cinders beneath the fill are expected to significantly reduce the volume of contaminants from the Turnpike property. The silty-clay soils beneath the three-to-five foot zone would be left on the Turnpike property because these soils are expected to retard downward migration of future leachate to the fractured bedrock below. Quantitative soil clean-up standards are not included in Alternative 8 because soil removal criteria are proposed to be based on depth from the surface — not on concentrations of contaminants.

Design and construction activities related to widening the Turnpike will need to be consistent with remedial objectives for the LOU. Additional long-term leachate collection may be needed on the Turnpike property if contamination left in place, after excavation on the Turnpike property, is determined to pose a significant risk. Long-term leachate collection on the Turnpike property would be addressed in RD, once the Turnpike Commission has submitted plans to EPA regarding potential widening of the Turnpike and after the potential direction of leachate flow beneath the landfill is identified.

The Land Ban would require that hazardous wastes, if excavated after capping, must be treated prior to off-site disposal. Excavation from the Turnpike property and on-site placement prior to capping would address the Turnpike Commission's concerns and meet Land Ban requirements. Excavation, incineration, and off-site disposal after the cap is installed are estimated to cost about $6 million. Excavation and on-site disposal, as included in the selected remedy, is estimated to cost about $350,000. Additional costs pertaining to excavation, capping, post-excavation soil sampling and O&M at the Turnpike property will total $238,139.

As with any older solid waste unit, there is potential for encountering one or more containers of hazardous waste during RD/RA. In addition, on-site soil sampling during the RI indicated that oil-contaminated soils, especially near car-truck garage maintenance areas, may be contaminated with particularly high concentrations of PAHs. Removal of such containers and oil-contaminated soils would be implementable and cost-effective. Removal of shallow oil-contaminated soil is expected to remove surface PAHs and thereby reduce the risk from inhalation and ingestion of dusts and from migration through infiltration and surface runoff. These materials would be disposed in compliance with Land Ban requirements.

Monitoring data collected from leachate, the vadose zone, and ground water would be used to evaluate the effectiveness of the remedy in preventing leachate generation and thereby minimize the release of contaminants to ground water. Surface water monitoring would support evaluation of possible impacts on the stream adjacent to the site. Landfill gas monitoring would characterize gas migration during O&M in order to retrofit the cap should gas buildup threaten cap integrity. The monitoring program would be developed during RD.

The same statistical approach to ground water monitoring and to determining when and how to terminate pumping, to be developed as part of RD for the IWOU, will be applied under Alternative 8 for the LOU. At a minimum, the vadose zone and ground water monitoring program to be designed for the LOU would include the same frequency and constituents as the IWOU monitoring program. The chemicals of concern listed in Exhibit 15 and others as appropriate will be included in the monitoring program for both operable units.

(c) Volumes of Contaminants Left On-site - Under Alternative 8, approximately 125,000 cubic yards of trash, approximately 33,000 cubic yards of cinder fill and an undetermined volume of deeper contaminated soils and bedrock would be left on-site. 7,965 cubic yards* of trash, cinders, and underlying fill/soils from the Pennsylvania Turnpike property will be consolidated onto the site. An estimated 2.5 million gallons of existing leachate and 3,000 gallons of leachate estimated to otherwise be generated each year will be directly removed and treated.

(d) Risk Reduction - Alternative 8 - The Risk Assessment for the LOU was based on the prediction of the movement of contaminants found in leachate, cinder fill, soils and shallow sediments sampled primarily in the central and eastern portions of the site and on adjacent properties. The Fate-and-Transport Assessment predicts that ground water affected by surface disposal is and/or may in the future be contaminated with bis(2-chloroethyl)ether and volatiles at levels that present significant risk. Ingestion of soil and inhalation of fugitive dusts constitute the next highest risk pathways for carcinogens. The selected remedy focuses on these risk pathways.

*5,230 cubic yards of cinders and trash plus 2,735 cubic yards of soils. See "Letter Report, Volumes and Gross Estimates for Excavation of Fill Material and Soils in the PA Turnpike Property," prepared by Camp Dresser and McKee, Inc. and dated August 14, 1984.

Runoff and erosion controls and a PA cap are expected to reduce ground water carcinogenic risk for the duration of O&M by more than three orders of magnitude, from 8.4 x 10^{-3} to about 8.4 x 10^{-6}. Leachate collection is expected to further reduce risks by one-half, resulting in ground water carcinogenic risk of about 4.2 x 10^{-6}.* These technologies specifically would reduce leachate, which is considered the medium of greatest concern. Additionally, capping would eliminate the next highest risk pathways for carcinogens, ingestion of soil and inhalation of fugitive dusts by on-site workers. Thus, the total upper-bound excess lifetime risk to a maximally exposed individual for Alternative 8 is 4.2 x 10^{-6}.

(e) Ground Water Clean-up Goals - Exhibit 15 lists ground water clean-up ARARs proposed for both operable units. Nine of the chemical-specific ground water clean-up ARARs proposed in Exhibit 15 for the LOU are included in the list of ground water clean-up ARARs for the IWOU. In order to achieve consistency with the IWOU, the numerical value of the chemical-specific ARARs are the same for both operable nits. For the ten remaining chemicals, EPA used the same process of selecting numerical ground water clean-up ARARs, described below, as for the IWOU. As stated in the Declaration to this ROD and in the IWOU ROD, aquifer clean-up ARARs will be reevaluated as part of EPA's Five-Year Reviews.

Ground water clean-up ARARs would be updated as the aquifer is characterized further during RD/RA for both operable units. Specific criteria for determining whether ground water is leaving the site, which will apply to both operable units, will be determined during RD for both operable units, based on water level and other relevant information to be collected as part of ground water monitoring during IWOU ground water recovery.

EPA selected aquifer restoration in the IWOU ROD as the clean-up goal for the site because data uncertainties and complexities related to the movement of wastes through the aquifer make predictions difficult regarding potential off-site release which would pose a risk to human health and the environment. Under Section 121(d)(2)(B)(ii) of SARA, alternate concentration limits may not be applied at the property line if human exposure may occur beyond the boundary of the facility unless:

(I) there are known and projected points of entry of ground water into surface water;

(II) on the basis of measurements or projections, there is or will be no statistically significant increase of constituents from ground water in surface water at the point of entry or at any point where there is reason to believe accumulation of constituents may occur downstream; and

* This risk value should be compared to that derived for the LOU if ground water clean-up criteria are met (4 x 10^{-3}) as listed in Exhibit 18.

(III) the remedial action includes enforceable measures that will preclude human exposure at any point between the facility boundary and all known or projected points of entry of ground water into surface water.

EPA was not prepared to conclude that the existing measurements for projections establish that there is or will be no statistically significant increase of constituents as described in (II) above.

Ground water clean-up criteria (ARARs) proposed in the IWOU ROD were based on the most conservative value derived from the following: Maximum Conrminnr Lwcwla (MXLs), Maximum Contaminent Level Goals (MCLGs), Aquatic Water Quality Criteria, Drinking Water Equivalent Levels, Suggested No Adverse Effect Levels, models developed during the Risk Assessment, processes described in the Superfund Public Health Evaluation Manual, and specific values accepted by EPA (where no other ARARs exist). Consistent with EPA Interim ARAR Guidance dated July 14, 1987, MCLs, where available, were used. These were based on identifying the aquifer of concern as equivalent to a Class IIA Aquifer, a current source of drinking water. Although more recent guidance now allows EPA to select ground water clean-up goals that are more protective than MCLs, the same approach to developing ARARs for ground water is needed for both operable units. The strong emphasis on periodic reevaluation of ground water clean-up goals in both RODs will allow flexibility in responding to new guidance and new data on the site.

Five compounds considered to be regional contaminants (1,1-dichloroethane, 1,2-dichloroethane, benzene, trichloroethene and 1,2-dichloropropane) were proposed in the IWOU ROD to be remediated to the most conservative value of the following three criteria:

- Average concentrations of the compounds in the Estock, Hubing, and HR-1 wells, to be modified as additional background wells are developed;
- Average concentrations of the compounds in wells on-site (excluding HR-2-195, HR-4-195, HR-4-295, HR-5-192, and HR cluster 1);
- Proposed chemical-specific ARARs for a Class IIA aquifer multiplied by a dilution factor of 33 as discussed in the IWOU FS.

ARARs proposed in the IWOU ROD were based on the assumption that regional ground water contamination would not change in the future. The IWOU ROD states that the target criteria for regional contaminants could be changed, using the same criteria listed above with averages recalculated with new values, if background contamination increases.

(f) ARARs for Discontinuance of Ground Water Pumping - One approach to determine when and whether to discontinue pumping will be used for both operable units. As with the IWOU, ground water clean-up criteria would be applied to ground water quality monitored at both recovery and monitoring wells. The operation of the ground water recovery and treatment system may be discontinued when the upper limit of the mean concentration of each indicator parameter (from the five most contaminated monitoring and/or recovery wells associated with the ground water treatment and recovery system as defined by each period of sampling or other basis to be determined in RD) is less than the appropriate clean-up criteria. A statistical tool, such as the Student's T Test, would be used to define the upper range within which the mean concentration of a representative sample would occur. The upper limit of the sample mean must be below the specified clean-up criteria for four consecutive quarterly monitoring events before the treatment system would be discontinued. This will ensure that seasonal fluctuations in site conditions are considered in the evaluation. If sufficient information determines that regional influences are responsible for the observed levels of contaminants above the specified criteria, the criteria may be waived for those compounds. The pump-and-treat system would be reactivated if the concentrations of the indicator parameters show a statistically significant increase above the clean-up criteria in two consecutive quarters.

Individual ground water extraction wells may be removed from the ground water recovery and treatment system independent of full system shutdown. If ground water contaminant levels from an individual extraction well are below the clean-up criteria for four consecutive quarters, then the well may be taken off-line. Monitoring of off-line wells would continue on a quarterly basis. The reaction of ground water quality at other wells from the shutdown of individual extraction wells also would be observed to ensure that the effectiveness of the ground water recovery and treatment system is maintained. A discontinued well would be reactivated as a recovery well if the concentration of the indicator parameters during the quarterly monitoring exceeds the clean-up criteria for two consecutive quarters. Again, requirements for recovery well or system shutdown for those parameters that are regional contaminants may be waived if sufficient information determines that regional influences are responsible for the observed contaminant concentrations.

(g) Performance Criteria (ARARs) for Ground Water Treatment - ARARs for ground water treatment will be based on the discharge option to be selected. For discharge of the treated effluent to Frog Run, compliance with NPDES disharge permit requirements, which include the PA Toxic Strategy, would be applied. PA DER may require that discharge at the property boundary must not adversely impact water quality and aquatic life at the point where it discharges into the point of continuous flow and that treatment to the 10^{-5} or 10^{-6} cancer risk level be achieved.

If part of the treated water is discharged back to the ground water through an infiltration gallery to "flush" the unsaturated zone, drinking water standards or human health criteria, whichever is more stringent, would apply to the treated effluent. The equivalent of an Underground Injection Well permit and Delaware River Basin Commission approval would be needed for this disposal option.

(h) Performance Criteria (ARARs) for Air Emissions - Exhibit 17 to the IWOU ROD lists air quality guidelines that would apply to air emissions from air strippers or any other treatment options implemented at the site. Furthermore, if VOC emissions are determined to jeopardize the attainment of the ozone standard, emission controls would be required to reduce VOC emissions to an acceptable level. This determination would be made by the PA DER on a case-by-case basis.

(i) Performance Criteria (ARARs) for Off-site Disposal - EPA'S Off-site Policy prohibits the use for off-site disposal of hazardous waste of a facility that has significant outstanding Class I violations under RCRA. The materials that are expected to be disposed off-site would be soil excavated from shallow oil-stained areas, cuttings from the drilling of wells, and contaminated equipment or garb used by workers. The applicaation of the Land Ban for disposal of these materials will need to be considered.

(j) Costs - Costs associated with Alternative 8 are described in the following documents, which are included in the Administrative Record for the LOU:

- "General Scope of Work to Characterize the Cinder Fill in the Western Portion of the Henderson Road Landfill Operable Unit," prepared by Camp Dresser & McKee, Inc., dated July 7, 1989;
- "Henderson Road Landfill Operating Unit Estimated Costs of EPA Preferred Remedy," prepared by Camp Dresser & McKee, dated July 11, 1989;
- "Henderson Road Landfill Operable Unit Estimated Costs of EPA Preferred Remedy," prepared by Camp Dresser & McKee, Inc., dated July 21, 1989;
- "Volumes and Gross Cost Estimates for Excavation of Fill Material and Soils on the Pennsylvania Turnpike Property," prepared by Camp Dresser & McKee, Inc., dated August 14, 1989.

These costs are summarized in Table 1 .

TABLE 1

HENDERSON ROAD LOU
ESTIMATED COSTS OF EPA's PREFERRED REMEDY

Item	Estimated Construction Cost	Annual Operation and Maintenance Cost ($/yr)	Total Present Worth (1)
Alternative 3	2,472,000	96,700	3,475,000
Alternative 7	444,600	104,000	1,523,000
Turnpike Excavation & Remedial Action	509,012	6,060	566,139
Soil & Container Removal	89,900	N/A	89,900
Western Portion Characterization Evaluation	42,000	N/A	42,000
Biannual Evaluation	N/A	6,500	29,170
Characterization of Low Permability Layer Beneath LOU	17,500	N/A	17,500
Potable Water Line Relocation	1,500,000	N/A	1,500,000
Post Excavation Soil Sampling at Turnpike Property	22,000	N/A	22,000
Total	5,097,012	213,260	7,264,709

(1) Computed for a 30-year study period at cost of capital equal to 10%

VIII. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

In the draft FS, the information from the draft RI for the LOU was used to identify, screen and evaluate six alternatives plus one contingent alternative for addressing the risks posed by the LOU.

Alternatives 1 through 7 do not address how remediation of the LOU would be coordinated with the complex remediation planned for the IWOU, do not address the Turnpike Commissions's request to excavate on the Turnpike property, nor PA DER's concern that the water line on the eastern portion of the site should be moved. The following factors were considered during the FS in screening and evaluating the alternatives:

(1) protectiveness of human health and the environment;

(2) conformance with statutory requirements. Major requirements include restoring the aquifer beneath the site to Class IIA Aquifer standards, State closure requirements for capping, leachate collection, and ground water monitoring, performance standards for discharge of ground water and leachate into Matsunk Sewage Treatment Plant or Frog Run, or reinjection into the aquifer and State air emission requirements;

(3) long-term effectiveness. Permanent solutions are preferred;

(4) short-term effectiveness;

(5) implementability i.e., technical and administrative feasibility;

(6) cost;

(7) reduction in volume, toxicity and mobility of waste. Emphasis is placed on treating wastes on-site, wherever possible, and applying innovative technologies;

(8) state acceptance;

(9) anticipated community acceptance.

These nine factors are compared in Table 2 and discussed below.

TABLE 2

SUMMARY OF DETAILED ALTERNATIVES EVALUATED IN FS
HENDERSON ROAD LANDFILL OPERABLE UNIT

Alternative	Description	Key Evaluation Criteria*	Cost
1.	No action/minimal action - fencing - deed restrictions and access agreements - monitoring	Unacceptable risk ($1x10^{-2}$).	$ 1,077,000
2.	(a) RCRA cap (b) PA solid waste cap - bituminous cap for cinders - deed restrictions and access agreements - monitoring	Does not address present leachate, major media of concern. Does not reduce volume or toxicity. Eliminates air exposure and reduces ground water risk three orders of magnitude (Risk = $8x10^{-6}$).	(a)$ 3,420,000 (b)$ 2,696,000
3.	- Leachate collection and treatment (a) RCRA cap (b) PA solid waste cap - bituminous cap for cinders - deed restrictions and access agreements - monitoring	Leachate collection reduces ground water risk by one-half ($4x10^{-6}$). Reduces mobility toxicity, and volume.	(a)$ 4,199,000 (b)$ 3,475,000
4.	- In-situ volatilization - leachate coll. & treatment (a) RCRA cap (b) PA solid waste cap - bituminous cap for cinders - deed restrictions and access agreements - monitoring	More reduction in mobility, toxicity, and volume, and risk reduced by another one quarter. However, not expected to be successful and not cost-effective (Risk = $3 x 10^{-6}$).	(a)$ 7,332,000 (b)$ 6,609,000
5.	- Partial excavation (a) off-site incineration/off-site disposal (b) off-site disposal only - PA solid waste cap - bituminous cap for cinders - deed restrictions and access agreements - monitoring	(a) Sorting of processable and nonprocessable wastes would be difficult. (b) Land ban would preclude. Risk slightly less than Alternative 2, based on same volume of leachate produced (Risk <$8x10^{-6}$).	(a)$ 12,621,000 (b)$ 5,696,000

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*Key Evaluation Criteria in this ROD are different than those presented in draft Table 5-1 of draft FS, because EPA disagrees with the respondents' approach to assessing risk for each alternative and certain major reasons for eliminating/selecting alternatives that are described in draft FS.

SUMMARY OF DETAILED ALTERNATIVES EVALUATED IN FS
HENDERSON ROAD LANDFILL OPERABLE UNIT

Alternative	Description	Key Evaluation Criteria	Cost
6.	- Major excavation (a) off-site incineration/off-site disposal	(a) Sorting of processable and nonprocessable wastes would be difficult. (b) Land ban would preclude. Eliminates major source, but some contamination still left and leachate still to be generated (Risk <8x10^{-6}).	(a)$131,137,000
7.	- Contingency ground water recovery and treatment	Meets ARARs for ground water and is protective. No source control and does not address air/soil exposure.	$ 1,523,000
8.	PREFERRED REMEDY		
	- Alternative 3b	Feasible, will meet ARARs, & focuses on major media of concern (leachate). Attention to water line and characterization in western portion of site is more protective than Alternative 3 (Risk < 4 x 10^{-6}).	$ 3,475,000
	- Alternative 7 in coordination with IWOU		$ 1,523,000
	- characterization of low permeability layer beneath LOU		$ 17,500
	- potable water line relocation*		$ 1,500,000
	- oil stained, shallow soil and container removal		$ 89,000
	(b) off-site disposal only		
	- limited PA solid waste cap		(b)$ 38,316,000
	- limited vegetative cover		
	- bituminous cap for cinders		
	- deed restrictions and access agreements		
	- monitoring		
	- Turnpike excavation, remediation and long-term O&M		$ 509,012
	- additional investigation and remediation in western portion of site in coordination with IWOU		$ 42,000
	- biannual evaluation		$ 29,170
	- post excavation soil sampling at Turnpike property		$ 22,000
	- Total		$ 7,264,709

Relocation of water line, at $1.5 million is included for costing purposes. Alternate engineering solutions also may be considered in RD. Remedial objectives and PADER concerns must be met.

Alternative 1 - No Action/Minimal Action - Alternative 1 was rejected because it would result in an unacceptable risk.

Alternative 2 - Runon, Runoff and Erosion Controls and Capping - A RCRA or PA cap would enhance runoff, control erosion, contain hazardous substances in the fill, and prevent exposure to contaminated materials through direct contact, dust or vapors and minimize filtration of water into the fill material. Monitoring would serve to identify the effects of site operations as described in Alternative 1.

However, this alternative would not directly remediate leachate, trash, fill, or ground water presently on-site, would leave landfilled wastes in place, and would not address how remediation of the LOU would be coordinated with the complex remediation planned for the IWOU. The effect of an asphalt cap over the western portion of the site is unknown, since this portion of the site has not been adequately characterized. Finally, Alternative 2 would not address ground water that is already contaminated.

Alternative 3 - Runon, Runoff and Erosion Controls, Capping, and Leachate Collection - The leachate collection system would drain liquids presently accumulated at the base of the landfill and collect residual leachate once the cap is installed. As in Alternative 2, protectiveness of human health and the environment would be addressed to the extent that surface runoff and future leachate generation would be reduced. By providing a means to directly monitor leachate within the landfill, this alternative would provide additional effectiveness monitoring of the cap during O&M.

However, existing leachate would not be recovered as quickly as possible and landfilled wastes would be left in place, possibly above health-based levels over the long term. The FS does not indicate how remediation of this operable unit would be coordinated with the IWOU. The effect of an asphalt cap over the western portion of the site is unknown. Finally, this alternative would not address ground water that is already contaminated.

Alternative 4 - Runon, Runoff and Erosion Controls, Capping, Leachate Collection and In-Situ Volatilization - This alternative would reduce infiltration of water through the landfill, contain hazardous substances in the fill, soil, and leachate, prevent exposure through airborne dusts and vapors, and would provide for the removal and treatment of any liquids or gases emanating from the unit for the duration of O&M. Toxicity and mobility of contaminants, including volatiles which comprise about one quarter of the risk associated with ground water, would be reduced somewhat through treatment of leachate and gases. If Alternative 4 reduces volatiles statutory requirements for clean-up would exceed RCRA closure requirements. Furthermore, in-situ volatilization is considered an innovative technology.

Although the volume of wastes may be somewhat reduced with in-situ volatilization, this technology is not expected to achieve a substantial reduction in volatile organic compound volume nor to address bis(2-chloroethyl)ether. Bis(2-chloroethyl)ether is not very volatile but comprises about three quarters of the carcinogenic risk associated with ground water. Thus, many wastes comprising most of the risk, including volatile organic compounds and bis(2-chloroethyl)ether, would still be left in place.

As in Alternative 2, existing leachate would not be recovered as quickly as possible under Alternative 4. The FS does not indicate how remediation of this operable unit would be coordinated with the IWOU. The effect of an asphalt cap is unknown as discussed above. Finally, contaminated ground water would not be directly addressed through this alternative.

Alternative 5 - Dewatering and Partial Excavation, Off-Site Disposal, Runon, Runoff and Erosion Controls and PA Solid Waste Cap - Incineration and landfilling of excavated waste would result in a reduction in volume, toxicity, and mobility. Based on incineration and land disposal resulting in generation of leachate in volumes and concentrations about equal to Alternative 2, Alternative 5 would reduce toxicity and mobility only slightly when compared to capping. Furthermore, acute hazardous wastes warranting immediate excavation to reduce risk were not found during the RI. This alternative may actually increase short-term risks via air-borne dusts and vapors.

Alternative 5 would be difficult to implement due to sorting problems. The FS does not indicate how remediation of this operable unit would be coordinated with the IWOU. The effect of an asphalt cap over the western portion of the site is unknown. Finally, this alternative does not address ground water that is already contaminated.

Alternative 6 - Dewatering and Major Excavation, Off-site Disposal, Limited PA Solid Waste Cap, Limited Vegetative Cover - Full excavation, treatment, and off-site disposal would achieve a permanent solution, and result in a reduction in volume, toxicity and mobility of chemicals of concern. Most of the risk associated with the landfill would be addressed under this alternative. Alternative 6 is expected to meet long-term ARARs.

However, contaminated soils and cinders outside the area identified as "saturated" would be left in place, so that infiltration could still release contaminants to the ground water. Full excavation and incineration may increase short-term risks via air-borne dusts and vapors, be difficult to implement due to sorting problems, and is not considered cost effective. The FS does not indicate how remediation of this operable unit would be coordinated with the IWOU. The effect of an asphalt cap on the western portion of the site is unknown. Finally, this alternative does not address ground water that is already contaminated.

Alternative 7 - Contingency Ground Water Recovery and Treatment - This alternative would prevent additional off-site releases of contamination to the regional aquifer. Over a long period of time, on-site ground water contaminaton may be reduced to some degree and the ground water risk would be reduced. However, ground water pumping alone would not address surface sources of contamination.

Alternative 8 - Capping, Short and Long-Term Leachate Collection, Turnpike Excavation, Ground Water Pumping, Coordination with IWOU-Alternative 8 focuses on the primary risk pathways — leachate and airborne dusts — and therefore is the alternative most protective of human health and the environment. The PA cap and leachate collection system are expected to meet state requirements. Consolidation of materials from the Turnpike property to the Henderson Road Site is expected to comply with Land Ban requirements. Short-term leachate collection and removal of oil-contaminated soils and containerized waste, if encountered, would promote short-term effectiveness.

Alternative 8 is the only alternative that addresses the need to ensure that the PSWC water line does not interfere with remedial objectives. PA DER has expressed additional concerns (see Responsiveness Summary). As part of Alternative 8, criteria for designing a means of addressing these concerns, to be applied during RD, will include requirements that remedial objectives and State ARARs are met.

Excavation of the Turnpike property is consistent with the PA Turnpike Commission's request. However, the Turnpike Commission has requested that the costs of additional characterization work, to be performed by the Turnpike Commission, be reimbursed from the respondents and that institutional measures not hinder future expansion in any manner. Such costs are not included in Alternative 8.

Public comments on the Proposed Plan are addressed in the Responsiveness Summary.

IX. THE SELECTED REMEDY

A. Summary of Major Factors and Criteria Associated with Selected Remedy

EPA developed Alternative 8 as the selected remedy based on consideration of the following:

- protection of human health and the environment and compliance with ARARs, in light of the uncertainty related to a potential off-site release (discussed in the IWOU ROD) and uncertainty regarding the ground water risk posed from the western portion of the site;

- the overall implementability of each alternative; i.e., direct source control options, such as in-situ volatilization or excavation and control options, such as in-situ volatilization or excavation and treatment, are expected to be difficult to implement successfully;
- the need to coordinate, with RD/RA planned for the IWOU, predesign activities proposed and remedial action to be selected for the western portion of the site, ground water recovery, site monitoring and reporting, and all compliance criteria;
- plans under development by the Turnpike Commission to widen the Pennsylvania Turnpike;
- the need to implement short-term remedial options, where appropriate and cost effective.

While Alternative 1 through 7 address some of these considerations to some extent, no Alternative listed in the draft FS, along with contingent Alternative 7, adequately addresses all of these.

Alternative 8, developed by EPA and selected as the remedy for LOU, is believed to provide the best balance of trade-offs among alternatives. EPA expects this alternative to be protective for as long as the remedy is operated and maintained. The selected alternative will reduce the risk from ground water, soil, fill materials, leachate and air to an acceptable level by:

(1) reducing the mobility of contaminants in soil, fill and leachate;

(2) preventing the generation of new leachate;

(3) reducing the potential for release of site contaminants through fugitive particulate or vapor emissions; and

(4) containing ground water affected by the LOU.

The selected LOU remedy is consistant with the IWOU remedial objective to prevent a potential release to UMR. The selected remedy more effectively meets the evaluation criteria for selecting a remedy, listed in Section VIII, than Alternatives 1 through 7. The selected remedy has the greatest potential to meet aquifer restoration ARARs both on- and off-site. Also, the selected remedy is expected to have the highest level of state and community acceptance.

The selected remedy potentially offers the highest level of protection from contamination both on- and off-site by strategically locating recovery wells in coordination with the IWOU RD/RA. However, remediation of ground water in fractured limestone is expected to be very difficult and other sources in the region may significantly contribute to aquifer contamination.

Furthermore, only a small volume of wastes would be reduced through leachate collection and treatment and gas venting.

The preferred alternative would leave landfilled wastes in place and may result in hazardous substances remaining on-site above health-based levels over the long-term. Therefore, as with the IWOU, a review will be conducted within five years after commencement of the RA for the LOU and every five years thereafter throughout O&M. This review will involve evaluation of whether technologies implemented provide adequate protection of human health and the environment, whether additional remediation is appropriate, whether progress is being made in meeting clean-up goals, and whether clean-up goals should be revised. EPA will conduct this review for the LOU, to the maximum extent practical without effecting a significant delay, simultaneously and in coordination with the Five Year Reviews for the IWOU.

B. Anticipated Changes and Decisions to be Made During RD/RA

Some changes may be made to the remedy as a result of the remedial design and construction process. Such changes in general will reflect usual modifications resulting from the engineering process. At a miniumum the following determinations associated with the LOU are anticipated to be made during RD/RA:

- selection of remedy for the western portion of the site (in coordination with IWOU);
- selection of final design specifications for regrading, capping (clay and vegetative cover are likely), and leachate collection at the Turnpike property after excavation;
- selection of final design specifications for the PA Solid Waste Cap;
- location of french drains;
- decision regarding relocation of the on-site water main or design of an alternate means of preventing and detecting leaks from the water main into the landfill and addressing PA DER concerns;
- location and number of ground water monitoring and recovery wells.

Determinations pertaining to initiation of additional ground water recovery, specific treatment for the ground water, discharge of treated ground water, and ground water pumping termination criteria, among others, are anticipated to be made as part of RD/RA for the IWOU (See Consent Decree and ROD for IWOU). Such determinations will be applied to the LOU, as appropriate, so that only one set of criteria is applied for implementation of ground water recovery and monitoring for the site.

C. Risk Level to be Attained

The Risk Assessment for the LOU was based on the prediction of the movement of contaminants found in leachate, cinder fill, soils, and shallow sediments sampled primarily in the central and eastern portions of the site and on Conrail property. Based on the Fate-and-Transport Assessment and the Risk Assessment, ground water beneath the site and on Conrail and Turnpike Commission properties may be contaminated with bis(2-chloroethyl)ether and volatiles at levels that present significant risk. Ingestion of soil and inhalation of fugitive dusts constitute the next highest risk pathways for carcinogens.

As summarized in Exhibit 11, the upper-bound excess lifetime risk to a maximally exposed individual predicted for the LOU totals 1 x 10^{-2}. 85 percent of this risk, or 8.4 x 10^{-3}, is attributed to exposure to ground water. As discussed in Section VI.B., 77 percent of this ground water risk is due to PAHs (60 percent), aldrin and PCBs (17 percent) which are not actually expected to be transported to ground water.

Data from wells drilled for the IWOU are not considered representative of ground water attributed to the LOU because the well locations are not representative of ground water affected or potentially affected by the landfill and other surface sources of contamination. The risk calculated for the IWOU, based on maximum concentrations of contaminants found in actual on-site wells, totals 3.6 x 10^{-2}. The IWOU ROD proposes clean-up to a 7 x 10^{-4} risk level based on the chemical-specific ARARs proposed in Exhibit 16 to the IWOU ROD. These risk values are presented here for comparison with that predicted for the LOU as described above. Ground water data, to be collected from additional wells for both the IWOU and LOU, will enable the risk assessment to be refined.

Runoff and erosion controls and a PA Solid Waste cap are expected to reduce ground water carcinogenic risk for the duration of O&M by about three orders of magnitude, from 8.4 x 10^{-3} to 8.4 x 10^{-6}. Leachate collection is expected to further reduce risks by one-half, resulting in ground water carcinogenic risk of 4.2 x 10^{-6}. Capping will eliminate the risk from inhalation of fugitive dusts and ingestion of soil and result in a total risk of less than 4 x 10^{-6} associated with the selected remedy.

The ground water carcinogenic risk assessed for the aquifer restoration objective, based on achieving Class IIA aquifer standards for the chemicals of concern proposed for the IWOU and LOU and modified to address regional contamination and excluding benzidine, is quantified at 4 x 10^{-3} (see Exhibit 18). Should background contamination increase or decrease, the proposed alternate concentrations would change too.

A risk level of less than 4 x 10^{-6} is within the range of risk of 10^{-4} to 10^{-7}, which is generally considered "acceptable" by EPA. However, complete aquifer restoration is not considered feasible because of background contamination. The risk based on IWOU and LOU ground water clean-up goals, 4 x 10^{-3}, (excluding benzidine) exceeds EPA's "acceptable" risk range. If higher standards for ground water clean-up are determined to be feasible at a later time, ground water clean-up ARARs may be changed accordingly.

Because the nature, extent and location of hazardous substances disposed into the LOU and injection well are uncertain, because background contamination may change in the future, and because the remediation implementation timeframe may exceed 30 years, EPA proposes conducting a formal evaluation of the clean-up goals and progress in achieving those goals every five years from the commencement of ground water pumping. This evaluation would be conducted for both operable units together. Depending on the outcome of those five-year evaluations risk levels to be attained may change.

D. Points of Compliance

Section 121(d) of SARA directs the point of compliance to be at the property line. Monitoring wells will be sited to observe the effects of ground water pumping and most effectively characterize ground water flow and quality. These locations may not directly coincide with the property line.

Clean-up criteria for ground water pumping for the LOU are based achieving ARARs in ground water beneath the site. This is consistent with clean-up criteria for ground water proposed for the IWOU.

The point of compliance for the ground water and leachate treatment system will be at the point of discharge for the air stripper and prior to any mixing zone. The point of compliance for emissions from the air stripper tower and landfill gas vents will be at the end of the stack or vent.

X. STATUTORY DETERMINATIONS

A. Determination of Endangerment

The total carcinogenic risk predicted for the LOU is calculated at 1 x 10^{-2}. Twelve chemicals of concern were used in deriving the carcinogenic risk from on-site ground water exposure.* The "Letter Report, Analysis of Contaminant Distribution and Fate-and Transport at the Henderson Road Landfill Operable Unit" and Draft FS (pages 4-39) conclude that the following chemicals of concern are mobile and pose as the most significant threat to ground water:

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*PAHs were combined into one group for the Risk Assessment (see Exhibit 16). However, PAHs and their associated ground water ARARs are listed individually as chemicals of concern in Exhibit 15.

- bis(2-chloroethyl)ether
- benzene
- PCE
- TCE

Additional risk is posed from ingestion of soils and inhalation of fugitive dusts. These threats via exposure to ground water, soils, and air constitute an endangerment pursuant to Section 106(a) of CERCLA.

B. Protection of Human Health and the Environment

The selected remedy is considered protective of human health and the environment. The treatment prescribed in the selected remedy for the LOU is designed to achieve an on-site risk of less than 4×10^{-6}, based on eliminating exposure from inhalation of fugitive dusts and reducing leachate. The existing on-site risk, based on predicting the movement of leachate from the LOU to ground water, is 1×10^{-2}.

The upper-bound lifetime risk to an individual maximally exposed to ground water in concentrations proposed as ARARs in Exhibit 15 totals 4×10^{-3} (excluding benzidine, which drove the risk assessment calculation up an additional two orders of magnitude because of its high detection limit and high carcinogenic potency). Since the approach for calculating risk for chemicals listed in Exhibit 15 is fundamentally different from that based on reducing the volume of leachate, it is not surprising that these risk values differ. Even though 4×10^{-3} exceeds EPA's "acceptable" risk range, the selected remedy is considered protective because it most effectively addresses the considerations listed in Section VIII.

As described in the IWOU ROD, if no significant future off-site release occurs, treatment at UMR is expected to continue to achieve a carcinogenic risk of 4.4×10^{-5} (based on maximum values) and 1.8×10^{-5} (based on average values). Treatment at the McIlvain well as part of IWOU RA is expected to reduce the carcinogenic risk there to below 1.0×10^{-6}.

For all excavation activities, measures will be needed to address dusts and odors during construction. Workers will need to wear protective clothing and equipment to reduce such short-term risks. Air pollution controls will be implemented, if needed, to meet State air emissions requirements.

C. Attainment of ARARs

Ground water clean-up goals (ARARs) and the basis for their selection are listed in Exhibit 15. These are based on appropriate and relevant requirements for a Class IIA Aquifer. Alternate concentration limits (ACLs) are proposed for 1,1-dichloroethane, 1,2-dichloroethane, benzene, 1,2-dichloropropane, and trichloroethene, as described in Section VII.B.8. The process that has been and will continue to be used to select ACLs is generally consistent with Section 264.94 of RCRA regulations and 1987 ACL Interim Final Guidance. Additional data on background contamination gathered during RD/RA (such as data from new background monitoring wells) will be incorporated into the evaluation of ARARs that is planned for every five years throughout O&M. Other factors that will be considered in the Five-Year Review will include implementability (i.e., are new technologies available to address source control with an expected substantial degree of success and is ground water quality improving at an acceptable rate during remediation) and effectiveness (i.e., is treatment in the landfill and/or unsaturated soils a cost-effective option to supplement ground water pumping).

Section VII.B.8. refers to Land Ban and off-site disposal requirements, NPDES permitting requirements, Injection Well Program requirements, and state air pollution emissions requirements. Off-site ground water withdrawals exceeding 10,000 gpd and surface and ground water discharges exceeding 50,000 gpd generally require a permit from the Delaware River Basin Commission. For on-site pumping, the equivalent of a permit from the Delaware River Basin Commission is required.

EPA's Underground Storage Tank regulations for tanks installed before December, 1988 require:

- corrosion protection;
- spill and overfill prevention; and
- leak detection.

These regulations apply to the on-site underground tanks.

D. Cost Effectiveness

The selected remedy, with estimated costs of about $7.3 million, affords overall effectiveness proportional to its costs such that the remedy represents a reasonable value for the money. Table 2 compares estimated costs affiliated with each component of all alternatives.

A PA Solid Waste cap is expected to provide the same degree of protectiveness as a RCRA cap, provided PA DER requirements for design are met. A PA Solid Waste cap is estimated to cost $723,765 less than a RCRA cap.

Leachate collection, estimated at $727,000 constitutes one of the major risk reduction components of the remedy. Because of the significant risk reduction anticipated to result from leachate collection, these costs are considered well justified.

As described in the IWOU ROD, costs of the aquifer restoration objective are viewed as reasonable at this time considering the mandate under the Ground Water Protection Program to provide a high level of protection to Class IIA aquifers. Should data gathered during RA indicate that aquifer restoration will be significantly more costly than originally estimated or that the selected remedy is less feasible than originally estimated, this new information will be factored into the periodic evaluation of ARARs. This is a cost-effective and practical approach.

The "Draft Letter Report on Volumes and Gross Cost Estimates for Excavation of Fill Material and Soils on the Pennsylvania Turnpike Property at the Henderson Road Site", prepared by Camp Dresser & McKee, Inc. and dated May 11, 1989, estimates that costs of incinerating soils below the trash and cinders on the Turnpike property would total $6,171,000. If these soils were moved off-site after a cap is installed on the LOU, treatment would be necessary under Land Ban requirements. Excavating and backfilling without treatment would cost $445,950. Because the same level of protectiveness is expected from excavating and remediating now instead of later, when treatment would be necessary, the costs to excavate and consolidate soils and fill from the Turnpike property are justified.

The "General Scope of Work to Characterize the Cinder Fill in the Western Portion of the HRLOU", prepared by Camp Dresser & Mckee and dated July 7, 1989, estimates the cost of additional characterization in the western portion of the site at $42,000. By completing this characterization simultaneously with the characterization of the unsaturated zone to be performed as part of the RD for the IWOU, one comprehensive remedy may be selected for the western portion of the site for both operable units. EPA expects that coordination of RD for both operable units in the western portion of the site will produce the most technically sound remedy in the most cost-effective fashion.

The approach to determining whether and how to cap, institute unsaturated zone treatment, or implement other remedies in the western portion of the site, conduct long-term monitoring, and conduct scheduled reevaluation of the remedy and proposed ARARs for both operable units together constitutes a cost-effective approach to balancing cost and overall effectiveness in light of the complexity of the site and potential overlap of influence on ground water between the two operable units.

E. Utilization of Permanent Solutions Employing Alternative-Technologies To The Maximum Extent Practicable

Alternative 4, in-situ volatilization, may be considered a more permanent solution, employing alternative technology, than the selected remedy. However, in-situ volatilization is not expected to be implementable and would not result in a substantial risk reduction (see Section VII.B.8). Alternatives 5 and 6, which would involve excavation of the landfill, are considered more permanent solutions than the selected remedy. However, these were determined to be less protective than Alternatives 3, 4, and 8. Additionally, Alternatives 5 and 6 are not considered to be cost-effective and would be difficult to implement.

F. Preference For Treatment As A Principal Element

The selected remedy involves treatment of leachate and ground water to address the principal threat posed by the LOU — ground water contamination. Although Alternatives 4, 5 and 6 involve treatment of additional media, these alternatives are not significantly more protective than the selected remedy and are not cost-effective. Furthermore, Alternatives 5 and 6 are expected to be particularly difficult to implement.

XI. DOCUMENTATION OF SIGNIFICANT CHANGES

The Proposed Plan for the site and Administrative Record were released for public comment in June, 1989. A report on fate-and-transport of contaminants in the LOU, prepared by Camp Dresser & McKee, was included as item III.22 to the Administrative Record. EPA reviewed all the comments that were submitted both verbally and in writing during the public comment period. In July and August, Camp Dresser & McKee submitted the last reports listed in the Administration Record. These reports address costs associated with Alternative 8. Upon review of these comments, EPA determined that no significant changes to the remedy, as identified originally in the Proposed Plan, were necessary.

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EXHIBIT 1

HENDERSON ROAD LANDFILL SITE II *
ADMINISTRATIVE RECORD FILE **
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III. REMEDIAL RESPONSE PLANNING

1) Letter to Mr. Alan Robinson, BCM Eastern, Inc., from Ms. Gerallyn Downes-Valls, U.S. EPA, re: Comments on the revised Work Plan for the soil sampling and analysis proposed for the Henderson Road Site Landfill Operable Unit, 11/2/87. P. 300001-300063. The following are attached:

    a) a Modified Sampling Procedure;

    b) a Quality Assurance Project Plan Review;

    c) a letter regarding analytical data collected from the Henderson Road NPL Site;

    d) a letter regarding modifications to the Work Plan/Project Operations Plan.

2) Transmittal letter to Ms. Gerallyn Downes-Valls, U.S. EPA, from Ms. Margaret E. Bonaker, BCM Eastern, Inc., re: Marked up copy of the November 17, 1987 letter from Ms. Gerallyn Downes-Valls to Mr. Alan Robinson, 11/18/87. P. 300064-300067. The marked up letter is attached.

3) Handwritten memorandum to Ms. Peg Bonaker, BCM Eastern, Inc., from Ms. Gerallyn Downes-Valls, U.S. EPA, re: Transmittal of the Henderson Road Detection Limits and Compounds, 1/20/88. P. 300068-300072. The tables of Detection Limits and Compounds are attached.

4) Report: A Field Trip Report for Henderson Road Site, prepared by NUS Corporation, 1/28/88. P. 300073-300189.

5) Report: Draft Landfill Investigation Report For The Henderson Road Site Landfill Operable Unit, prepared by BCM Eastern, Inc., 3/88. P. 300190-300311.

* Administrative Record File available 5/31/89, updated 9/21/89.

** For further documentation on this site, please refer to the Henderson Road Site Administrative Record.

Note: Company name or organizational affiliation is identified in the index only when it appears in the record.

6) Letter to Mr. Alan Robinson, BCM Eastern, Inc., from Ms. Gerallyn Downes-Valls, U.S. EPA, re: Transmittal of the inorganic data review, 3/4/88. P. 300312-300318. The amendment to the inorganic data validation is attached.

7) Report: Volume 1, Remedial Investigation Report Landfill Operable Unit, prepared by BCM Eastern, Inc., 5/89. P. 300319-300520. References are listed on P. 300515-300519.

8) Report: Volume 2, Remedial Investigation Report Landfill Operable Unit, prepared by BCM Eastern, Inc., 5/89. P. 300521-301240. References are listed on P. 301156 and 301198-301199.

9) Report: Feasibility Study Report Landfill Operable Unit, prepared by BCM Eastern, Inc., 4/89. P. 301241-301520.

10) Letter to Ms. Gerallyn Valls [sic], U.S. EPA, from Mr. Robert D. Buller, BCM Engineers [sic], re: Transmittal of recent published papers addressing the relationship between Polycyclic Aromatic Hydrocarbons (PAHs) and oil stains, 5/19/89. P. 301521-301532. Two papers entitled "Soil Cleanup Criteria for Selected Petroleum Products" and "Accumulation of Polycyclic Aromatic Hydrocarbons in Crankcase Oil" are attached.

11) Letter to Ms. Gerallyn Valls [sic], U.S. EPA, from Mr. Louis R. Martin, Pennsylvania Turnpike Commission, (PTC) re: Preliminary analysis of the estimated costs associated with the symmetrical and non-symmetrical [sic] widening of the Turnpike to six lanes, 5/23/89. P. 301533-301535.

12) Report: Comparison Study Analytical Data, Henderson Road Site, prepared by Versar, Inc., (undated). P. 301536-301572.

13) Deed between Bethlehem Steel Corporation to Mr. William J. O'Hara and Mrs. Betty E. O'Hara, 3/14/77. P. 301573-301577.

14) Letter to Ms. Carole Kurtz, Pennsylvania Department of Environmental Resources, from Mr. James J. Kayer, Pennsylvania Turnpike Commission, re: O'Hara Sanitation's continuing trespass upon Pennsylvania Turnpike Commission property, 12/14/88. P. 301578-301603. The following are attached:

    a) a letter regarding O'Hara Sanitation trespassing on Commission property;

    b) a letter regarding O'Hara's request for PTC cooperation of handling drainage;

    c) a letter regarding PTC's awaiting status of Engineering Data review sent to O'Hara;

    d) a letter regarding transmittal of comments and drawings;

e) a memorandum regarding the removal of clean fill from Turnpike property;

f) two site maps;

g) a memorandum regarding estimate of consequential damages;

h) five Pennsylvania Turnpike Commission forms;

i) a fence stakeout map;

j) excerpt from a Federal report;

k) three aerial photographs.

15) Letter to Mr. James Snyder, Pennsylvania Bureau of Waste Management, from Mr. Peter Schaul, U.S. EPA, re: Completion of the Remedial Investigation, 1/27/89. P. 301604-301607. A memorandum regarding closure requirements for a hazardous waste landfill is attached.

16) Letter to Ms. Gerallyn Downes-Valls, U.S. EPA, and Mr. Wayne Walters, U.S EPA, from Mr. Preston Luitweiler, and Mr. Mark Kropilak, Philadelphia Suburban Water Company (PSWC), re: PSWC's concerns about groundwater withdrawals in the UMR basin, 2/22/89. P. 301608-301610.

17) Letter to Mr. Bruce Smith, U.S. EPA, from Mr. Steven Speece, re: Comments on O'Hara Sanitation's position, 3/6/89. P. 301611-301612.

18) Letter to Ms. Gerallyn Valls [sic], U.S. EPA, from Mr. Steven Speece, re: Transmittal of all relevant documents concerning the Conrail and Pennsylvania Turnpike Commission matters, 4/14/89. P. 301613-301696. The following are attached:

a) a letter regarding the removal of clean fill from Turnpike property;

b) a letter regarding PTC stating they are awaiting for a review of Engineering Data;

c) a letter regarding information to be reviewed by O'Hara's counsel;

d) a letter regarding a meeting between PTC and O'Hara scheduled on July 11, 1989 at 11:00 A.M.;

e) a letter regarding the scheduled meeting with PTC.;

f) a letter regarding a meeting to discuss O'Hara's lack of activity;

g) a letter regarding setting up a meeting at the site;

h) a letter regarding a request for a meeting with O'Hara Sanitation Company representatives;

i) a letter regarding an inspection made on August 29, 1986 of the Turnpike's right-of-way;

j) an Active Status Certification form;

k) a letter regarding the Turnpike Survey Corps restaking the legal right of way;

l) a letter regarding inspection of the O'Hara Sanitation Company;

m) a letter regarding delaying an on-site inspection;

n) a letter regarding rescheduling a meeting until October 1984;

o) a letter regarding an on-site meeting;

p) a letter regarding an on-site meeting to resolve the situation at the site;

q) a letter regarding an immediate response to Mr. O'Hara's position;

r) a letter regarding PTC's offer of extension to answer the Complaint;

s) a letter regarding the transmittal of the Defendant's Brief in Support of Preliminary Objections;

t) a Notice and Complaint for Pennsylvania Turnpike Commission vs. O'Hara Sanitation Company;

u) an Answer to Complaint for Pennsylvania Turnpike Commission vs. O'Hara Sanitation Company;

v) a Praecipe for Argument List for Pennsylvania Turnpike Commission vs. O'Hara Sanitation Company;

w) an Order Sur Defendant's Preliminary Objections for Pennsylvania Turnpike Commission vs. O'Hara Sanitation Company;

x) a Preliminary Objection for Pennsylvania Turnpike Commission vs. O'Hara Sanitation Company;

y) an Order for Pennsylvania Turnpike Commission vs. O'Hara Sanitation Company;

z) a Defendant's Brief in Support of Preliminary Objections for Pennsylvania Turnpike Commission vs. O'Hara Sanitation Company;

aa) a Plaintiff's Brief in Opposition to Defendant's Preliminary Objections for Pennsylvania Turnpike Commission vs. O'Hara Sanitation Company;

bb) a Praecipe of Appearance for Pennsylvania Turnpike Commission vs. O'Hara Sanitation Company;

cc) a Certificate of Service for Pennsylvania Turnpike Commission vs. O'Hara Sanitation Company;

dd) a letter regarding work completed by O'Hara Sanitation Company;

ee) handwritten notes regarding telephone messages;

ff) a letter regarding Conrail's position for the proposed sale of Conrail property in King of Prussia, Pennsylvania;

gg) a letter regarding the purchase of Conrail property in King of Prussia, Pennsylvania;

hh) a letter regarding the encroachment on Conrail property by O'Hara Sanitation Company;

ii) a letter regarding O'Hara Sanitation Company dumping of substantial amount of waste material on Conrail property;

jj) a letter regarding O'Hara Sanitation Company encroachment of Consolidated Rail Corporation property;

kk) a Temporary License Agreement Permitting Entry of Property.

19) Letter to Honorable John Fullam, U.S. District Court, from Mr. Robert Smolski, U.S. Department of Justice, re: Transmittal of the United States' Petition For Approval and Entry of the Consent Decree of 4/17/89. P. 301697-301701. The Petition is attached.

20) Letter to Mr. James Snyder, Bureau of Waste Management, from Mr. Bruce Smith, U.S. EPA re: Proposed Plan for the Henderson Road NPL site, 5/19/89. P. 301702-301702.

21) Letter to Ms. Rose Harvell, U.S. EPA, from Mr. Harry Butler, CDM Federal Programs Corporation, re: Transmittal of the Draft Letter Report on Volumes and Gross Estimates for Excavation of Fill Material on the Pennsylvania Turnpike Property, Henderson Road Site, 5/30/89. P. 301703-301708. The report is attached.

22) Letter to Ms. Rose Harvell, U.S. EPA, from Mr. Harry Butler, CDM Federal Programs Corporation, re: Transmittal of the Letter Report on Analysis of Contaminant Distribution and Fate-and-Transport at the Henderson Road Landfill Operable Unit," 5/30/89. P. 301709-301725. The report is attached.

23) Letter to Mr. Robert Buller, BCM Engineers [sic], from Ms. Gerallyn Valls [sic], U.S. EPA, re: Draft comments on the Remedial Investigation and Feasibility Study, 6/9/89. P. 301726-301752. A letter regarding the transmittal of the Revised Remedial Investigation Report and the Final Feasibility Study Report is attached.

24) Report: The Henderson Road NPL Site Operable Unit Proposed Plan, prepared by U.S. EPA, (undated). P. 301753-301783.

25) Report: Supplement to Proposed Plan, Henderson Road NPL Site Landfill Operable Unit, prepared by U.S. EPA, (undated). P. 301784-301787.

26) Letter to Ms. Gerallyn Valls [sic], U.S. EPA, from Mr. Preston Luitweiler, Philadelphia Suburban Water Company, re: Relocating the 36-inch steel transmission main, 6/12/89. P. 301788-301798. An article entitled "Accumulation of Polycyclic Aromatic Hydrocarbons in Crankcase Oil" is attached.

27) Letter to Ms. Gerallyn Downes-Valls, U.S. EPA, from Ms. Debra S. Glover, Camp Dresser & McKee, Inc., re: Draft Letter Report on Volumes and Gross Cost Estimates for Excavation of Fill Material and Soils on the Pennsylvania Turnpike Property at the Henderson Road Site, 5/11/89. P. 301799-301802.

28) Letter to Ms. Gerallyn Downes-Valls, U.S. EPA, from Ms. Debra S. Glover, Camp Dresser & McKee, Inc., re: General Scope of Work to Characterize the Cinder Fill in the Western Portion of the Henderson Road Landfill Operable Unit, 7/7/89. P. 301803-301805. A Landfill Investigation Map is attached.

29) Letter to Ms. Gerallyn Downes-Valls, U.S. EPA, from Mr. Robert J. Delorenzo, Camp Dresser & McKee, Inc., re: Estimated Costs of EPA Preferred Remedy, 7/11/89. P. 301806-301811.

30) Letter to Ms. Gerallyn Downes-Valls, U.S. EPA, from Mr. Robert J. Delorenzo, Camp Dresser & McKee, Inc., re: Revised Estimated Costs of EPA Preferred Remedy, 7/21/89. P. 301812-301817.

31) Letter to Ms. Jean Wright, U.S. EPA, from Mr. Donald Senovich, Camp Dresser & McKee, Inc., re: Transmittal of the Letter Report entitled "Volumes and Gross Cost Estimates for Excavation of Fill Material and Soils on the Pennsylvania Turnpike Property", 8/14/89. P. 301818-301823. The Letter Report is attached.

32) Letter to Mr. Robert Buller, BCM Engineers, Planners and Scientists, from Ms. Gerallyn Valls [sic], U.S. EPA, re: Transmittal of EPA's comments to the Revised Remedial Investigation Report (May, 1989) and Feasibility Study Report for the Henderson Road Landfill Operable Unit (April, 1989), 8/18/89. P. 301824-301847. The comments are attached.

33) Letter to Ms. Jean Wright, U.S. EPA, from Mr. Donald Senovich, Camp Dresser & McKee, Inc., re: Transmittal of the Final Letter Report entitled "Comments to the Revised Remedial Investigation Report (May 1989) and Final Feasibility Study Report for the Henderson Road Landfill Operable Unit", 8/23/89. P. 301848-301872.

V. COMMUNITY INVOLVEMENT/CONGRESSIONAL CORRESPONDENCE/IMAGERY

1) Press Release from EPA Environmental News entitled "EPA Announces Availability of Proposed Plan For The Landfill Operable Unit At The Henderson Road", 6/16/89. P. 500001-500003.

2) Cover Page re: Correction to EPA Ad, (undated). P. 500004-500006. EPA's Proposed Plan is attached.

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COMPENDIUM OF CERCLA RESPONSE SELECTION GUIDANCE DOCUMENTS

Doc No	Vol	Title	Date	Authors	Status	Pages	Tier	Attachments	OSWER/EPA Number
2205	14	LINING OF WASTE CONTAINMENT AND OTHER IMPOUNDMENT FACILITIES	09/01/88	- MATRECON, INC - LANDRETH, R /HAZ/RISK REDUCTION ENGINEERING LAB	Final	950	2	FED REG	
2206	15	LINING OF WASTE IMPOUNDMENT AND DISPOSAL FACILITIES	03/01/83	- LANDRETH, R /MERL	Final	480	2		OSWER #9480.00-4
2207	15	PROCEDURES FOR MODELING FLOW THROUGH CLAY LINERS TO DETERMINE REQUIRED LINER THICKNESS	01/01/84	- OSW	Draft	145	2		OSWER #9480.00-9(D)
2208	15	RCRA GUIDANCE DOCUMENT: LANDFILL DESIGN LINER SYSTEMS AND FINAL COVER	07/01/82	- EPA	Draft	30	2		
2209	15	SETTLEMENT AND COVER SUBSIDENCE OF HAZARDOUS WASTE LANDFILLS PROJECT SUMMARY	05/01/85	- MURPHY, W L - GILBERT, P A	Final	4	2		EPA 600/S2 85 035
2210	15	SUPPLEMENTARY GUIDANCE ON DETERMINING LINER/LEACHATE COLLECTION SYSTEM COMPATIBILITY	08/07/86	- WEDDLE, B R /PERMITS AND STATE PROGRAMS DIV	Final	60	2	1) ANALYSIS AND FINGERPRINTING OF UNEXPOSED & EXPOSED POLYMERIC MEMBRANE LINERS MATRECON, INC 2) SEC. 3019 EXPOSURE INFO. AND HEALTH ASSESSMENTS	OSWER #9480.00-13
2211	15	TECHNICAL GUIDANCE DOCUMENT: CONSTRUCTION QUALITY ASSURANCE FOR HAZARDOUS WASTE LAND DISPOSAL FACILITIES	10/01/86	- HERRMANN, J G /HWERL/LAND POLLUTION CONTROL DIV - OSWER	Final	88	2		OSWER #9472.003
2212	15	TREATMENT OF REACTIVE WASTES AT HAZARDOUS WASTE LANDFILLS PROJECT SUMMARY	01/01/84	- SHEDDER D ET AL /ARTHUR D LITTLE, INC - LANDRETH, R /MERL	Final	4	2		EPA/600/S2 83/118
[illegible]	25	APPLICABILITY OF THE HSWA MINIMUM TECHNICAL REQUIREMENTS RESPECTING LINERS AND LEACHATE COLLECTION SYSTEMS [Secondary Reference]	04/01/85	- SKINNER, J /OSW	Final	3	2		OSWER #9480.01(85)

** RI/FS - Other Technologies

Doc No	Vol	Title	Date	Authors	Status	Pages	Tier	Attachments	OSWER/EPA Number
[illegible]	16	A COMPENDIUM OF TECHNOLOGIES USED IN THE TREATMENT OF HAZARDOUS WASTES	09/01/87	- ORD/CERI	Final	49	2		EPA/625/8 87/014

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COMPENDIUM OF CERCLA RESPONSE SELECTION GUIDANCE DOCUMENTS

Doc No	Vol	Title	Date	Authors	Status	Pages	Tier	Attachments	OSWER/EPA Number
2314	21	PROHIBITION ON THE PLACEMENT OF BULK LIQUID HAZARDOUS WASTE IN LANDFILLS-STATUTORY INTERPRETIVE GUIDANCE	06/11/86	- OSWER/OSW	Final	35	1	1) MEMO RE SAME SUBJECT FROM WILLIAMS, M.E./OSW	OSWER #9487.00-2A
2315	21	REVIEW OF IN-PLACE TREATMENT TECHNIQUES FOR CONTAMINATED SURFACE SOILS-VOL 2 BACKGROUND INFORMATION FOR IN-SITU TREATMENT	11/01/84	- SIMS, R.C., ET AL./JRB ASSOCIATES - BARKLEY, N./MERL	Final	350	1		EPA 540/2-84-003b
2316	21	REVIEW OF IN-PLACE TREATMENT TECHNIQUES FOR CONTAMINATED SURFACE SOILS-VOL 1 TECHNICAL EVALUATION	09/19/84	- OSWER/OERR - ORD/MERL	Final	165	1		EPA/540/2-84-003a
2317	22	SLURRY TRENCH CONSTRUCTION FOR POLLUTION MIGRATION CONTROL	02/01/84	- OERR - ORD/MERL	Final	220	1		EPA/540/2-84-001
2318	22	SYSTEMS TO ACCELERATE IN SITU STABILIZATION OF WASTE DEPOSITS	09/01/86	- AMDURER, M., ET AL./ENVIROSPHERE CO - GRUBE, W./HWERL	Final	285	1		EPA 540/2-86/003
2319	22	TECHNOLOGY SCREENING GUIDE FOR TREATMENT OF CERCLA SOILS AND SLUDGES	09/01/88	- OSWER/OERR	Final	130	1		EPA 540/2-88/004
2320	22	TREATMENT TECHNOLOGY BRIEFS: ALTERNATIVES TO HAZARDOUS WASTE LANDFILLS	07/01/86	- HWERL	Final	35	2		EPA/600/8-86/017

** RI/FS Ground Water Monitoring & Protection

Doc No	Vol	Title	Date	Authors	Status	Pages	Tier	Attachments	OSWER/EPA Number
2400	23	CRITERIA FOR IDENTIFYING AREAS OF VULNERABLE HYDROGEOLOGY UNDER RCRA - STATUTORY INTERPRETIVE GUIDANCE	07/01/86	- OSWER/OSW	Final	950	2		OSWER #9472.00-2A
2401	24	FINAL RCRA COMPREHENSIVE GROUND WATER MONITORING EVALUATION (CME) GUIDANCE DOCUMENT	12/19/86	- LUCERO, G.A./OWPE	Final	55	2	1) RELATIONSHIP OF TECHNICAL INADEQUACIES TO GROUND WATER PERFORMANCE STANDARDS	OSWER #9950.2
2402	24	GROUND WATER MONITORING AT CLEAN CLOSING SURFACE IMPOUNDMENT AND WASTE PILE UNITS	03/11/88	PORTER, J.W./OSWER	Final	1	2		OSWER #9476.00-14
2403	24	GROUND WATER PROTECTION STRATEGY	08/01/84	- OFFICE OF GROUND WATER PROTECTION	Final	65	2		EPA/440/6-84-002
2404	24	GUIDELINES FOR GROUND WATER CLASSIFICATION UNDER THE EPA GROUND WATER PROTECTION STRATEGY	12/01/86	- OFFICE OF GROUND-WATER PROTECTION	Draft	600	2		
2405	24	OPERATION AND MAINTENANCE INSPECTION GUIDE (RCRA GROUND WATER MONITORING SYSTEMS)	03/30/88	- OSWER/OWPE/RCRA ENFORCEMENT DIVISION	Final	50	2	1) TRANSMITTAL MEMO RE SAME SUBJECT	OSWER #9950.3

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COMPENDIUM OF CERCLA RESPONSE SELECTION GUIDANCE DOCUMENTS

Doc NO	Vol	Title	Date	Authors	Status	Pages	Tier	Attachments	OSWER/EPA Number
2208	15	RCRA GUIDANCE DOCUMENT LANDFILL DESIGN LINER SYSTEMS AND FINAL COVER [Secondary Reference]	07/01/82	- EPA	Draft	30	2		
9801	32	RCRA/CERCLA DECISIONS MADE ON REMEDY SELECTION [Secondary Reference]	06/24/85	- KILPATRICK, M /COMPLIANCE BRANCH OWPE	Final	3	2		

** Water Quality

Doc NO	Vol	Title	Date	Authors	Status	Pages	Tier	Attachments	OSWER/EPA Number
4000	26	ALTERNATE CONCENTRATION LIMIT GUIDANCE PART 1. ACL POLICY AND INFORMATION REQUIREMENTS	07/01/87	- OSW/WMD	Final	124	2		OSWER #9481.00-6C
4001	26	GUIDANCE DOCUMENT FOR PROVIDING ALTERNATE WATER SUPPLIES	02/01/88	- OERR	Final	64	2		OSWER #9355.3-01
4002	26	INTERIM FINAL GUIDANCE ON REMOVAL ACTION LEVELS AT CONTAMINATED DRINKING WATER SITES	10/06/87	- OSWER/OERR	Final	9	2		OSWER #9360.1-01
4003	26	QUALITY CRITERIA FOR WATER 1986	05/01/87	- OFFICE OF WATER REGULATIONS AND STANDARDS	Final	325	2		EPA/440/5-86-001
2301	16	CARBON ADSORPTION ISOTHERMS FOR TOXIC ORGANICS [Secondary Reference]	04/01/80	- DOBBS, R A /MERL - COHEN, J M /MERL	Final	321	2		EPA/600/8-80-023
1005	1	INFORMATION ON DRINKING WATER ACTION LEVELS [Secondary Reference]	04/19/88	- FIELDS, JR., T /OSWER/ERD	Final	17	2	1) MEMO: RELEASES FROM LAWFULLY APPLIED PESTICIDES 2) MEMO EDB CONTAMINATION 3) GUIDANCE FOR ETHYLENE DIBROMIDE IN DRINKING H2O	

** Risk Assessment

Doc NO	Vol	Title	Date	Authors	Status	Pages	Tier	Attachments	OSWER/EPA Number
5000	27	ATSDR HEALTH ASSESSMENTS ON NPL SITES	06/16/86	- DEPT OF HEALTH AND HUMAN SERVICES/ATSDR	Draft	14	2		
5001	27	CHEMICAL, PHYSICAL & BIOLOGICAL PROPERTIES OF COMPOUNDS PRESENT AT HAZARDOUS WASTE SITES	09/27/85	- CLEMENT ASSOCIATES, INC	Final	320	2		OSWER #9850.3
5002	27	FINAL GUIDANCE FOR THE COORDINATION OF ATSDR HEALTH ASSESSMENT ACTIVITIES WITH THE SUPERFUND REMEDIAL PROCESS	05/14/87	- PORTER, J W /OSWER/OERR - ATSDR	Final	22	2	1) SAME TITLE, DATED 4/22/87	OSWER #9285.4-02
5003	27	GUIDELINES FOR CARCINOGEN RISK ASSESSMENT (FEDERAL REGISTER SEPTEMBER 24, 1986, p. 33992)	09/24/86	- EPA	Final	13	2		

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COMPENDIUM OF CERCLA RESPONSE SELECTION GUIDANCE DOCUMENTS

Doc No	Vol	Title	Date	Authors	Status	Pages	Tier	Attachments	OSWER/EPA Number
5010	31	INTERIM POLICY FOR ASSESSING RISKS OF "DIOXINS" OTHER THAN 2,3,7,8-TCDD	01/07/87	- THOMAS, L M /EPA	Final	50	2	1) INTERIM PROCEDURES FOR ESTIMATING RISKS ASSOCIATED WITH EXPOSURES TO MIXTURES 10/86	
5011	31	PUBLIC HEALTH RISK EVALUATION DATABASE (PHRED) [USER'S MANUAL AND TWO DISKETTES CONTAINING THE DBASEIII PLUS SYSTEM ARE INCLUDED]	09/16/88	- OERR/TOXICS INTEGRATION BRANCH	Final	—	2		
5012	31	ROLE OF ACUTE TOXICITY BIOASSAYS IN THE REMEDIAL ACTION PROCESS AT HAZARDOUS WASTE SITES	08/01/87	- ATHEY, L A ET AL /PACIFIC NORTHWEST LABORATORY - MILLER, W E /CORVALLIS ENVIRONMENTAL RESEARCH LAB	Final	106	2		EPA/600/8 87/044
5013	31	SUPERFUND EXPOSURE ASSESSMENT MANUAL	04/01/88	- OERR	Final	160	1		OSWER #9285.5-1
5014	31	SUPERFUND PUBLIC HEALTH EVALUATION MANUAL	10/01/86	- OERR - OSWER	Final	500	1		OSWER #9285.4-1
5015	31	TOXICOLOGY HANDBOOK	08/01/85	- LIFE SYSTEMS, INC - TYBURSKI, T E /OWPE	Draft	136	2		OSWER #9850.2
8000	32	ENDANGERMENT ASSESSMENT GUIDANCE [Secondary Reference]	11/22/85	- PORTER, J W /OSWER	Final	11	2		OSWER #9850.0-1
**		Cost Analysis							
6000	32	REMEDIAL ACTION COSTING PROCEDURES MANUAL	10/01/87	- JRB ASSOCIATES/CH2M HILL - ORD/HWERL - OSWER/OERR	Final	56	1		
6001	32	REMOVAL COST MANAGEMENT MANUAL	04/01/88	- OSWER/OERR	Final	170	1		OSWER #9360.0-03B
1003	1	ENVIRONMENTAL REVIEW REQUIREMENTS FOR REMOVAL ACTIONS [Secondary Reference]	04/13/87	- OERR/ERD	Final	6	2		OSWER #9318.0-05
**		Community Relations							
7000	32	COMMUNITY RELATIONS IN SUPERFUND: A HANDBOOK (INTERIM VERSION)	06/01/88	- OERR	Final	188	2	1) CHAP. 6 OF THE COM. REL. HANDBOOK 11/03/88	OSWER #9230.0-03B

EXHIBIT 2

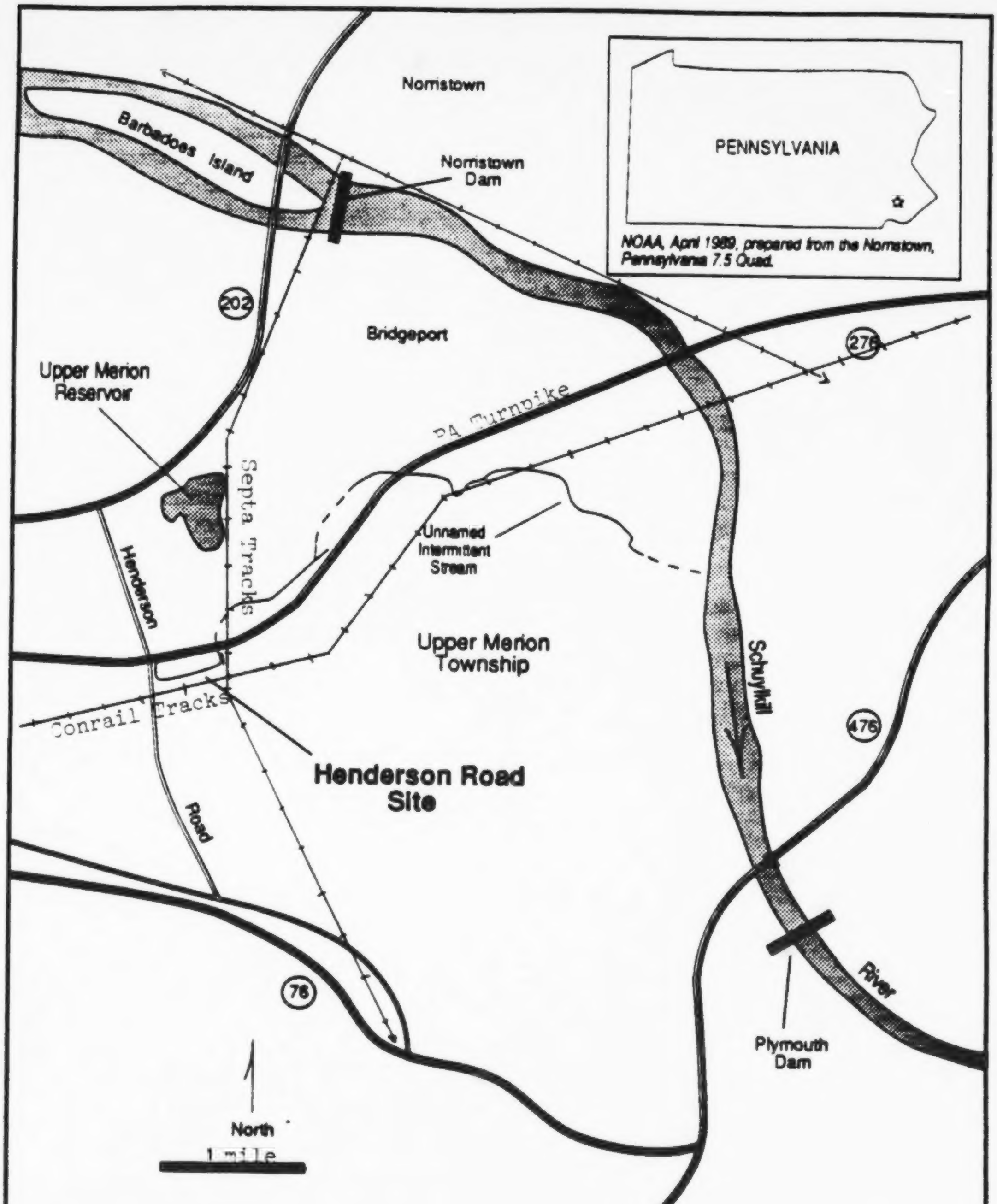
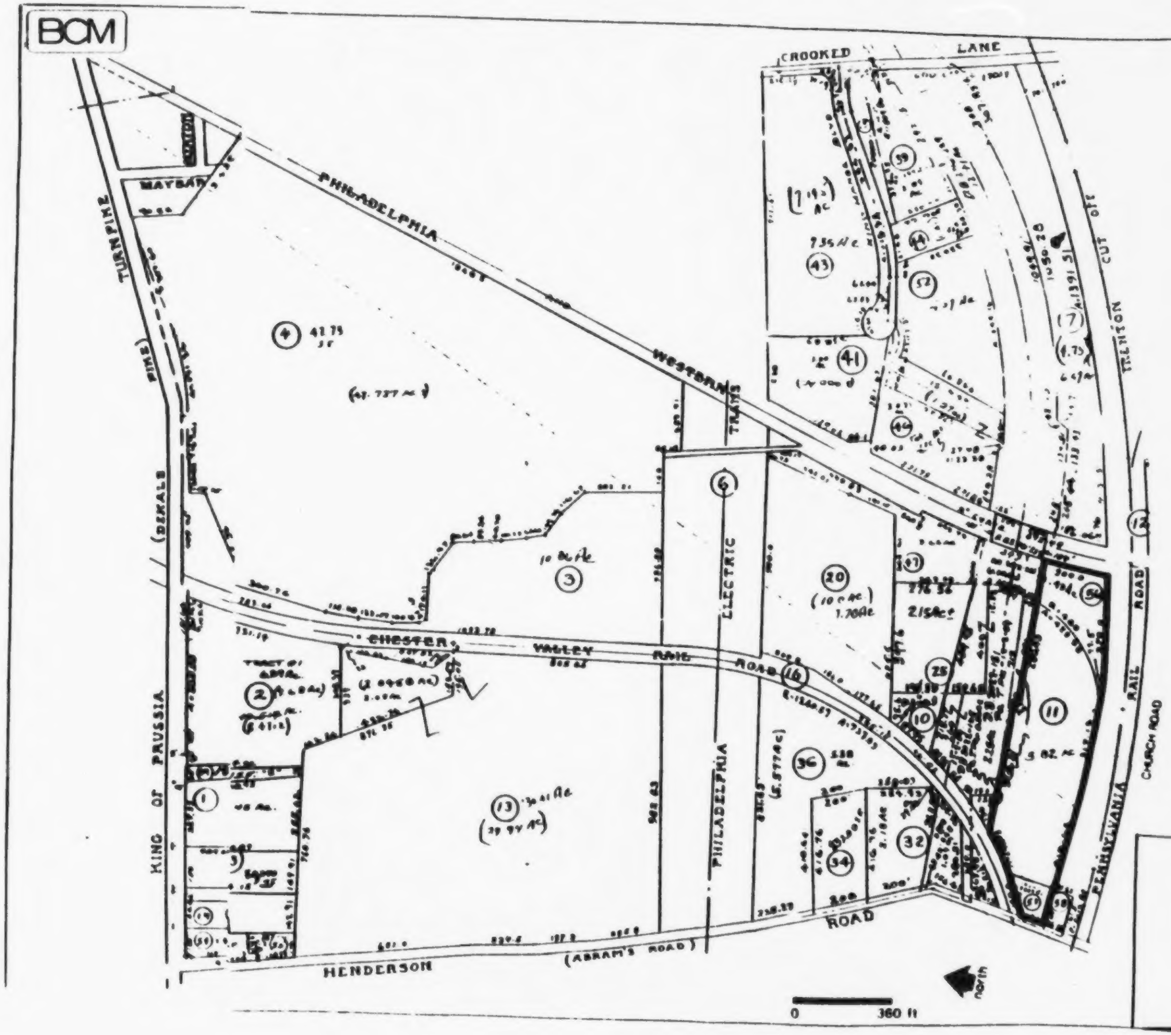

Norristown
Barbadoes Island
Norristown Dam
PENNSYLVANIA
NOAA, April 1989, prepared from the Norristown, Pennsylvania 7.5 Quad.
202
Bridgeport
276
Upper Merion Reservoir
PA Turnpike
Septa Tracks
Unnamed Intermittent Stream
Henderson
Upper Merion Township
Schuylkill
Conrail Tracks
476
Henderson Road Site
Road
76
River
Plymouth Dam
North
1 mile

Figure 1. The Henderson Road study area in Upper Merion Township, Pennsylvania.

Reproduced from best available copy.

EXHIBIT 3



BCM
CROOKED LANE
TRENTON CUT OFF
PENNSYLVANIA RAIL ROAD
CHURCH ROAD
PHILADELPHIA WESTERN TRANS
PHILADELPHIA ELECTRIC
CHESTER VALLEY RAIL ROAD
HENDERSON ROAD
(ABRAM'S ROAD)
KING OF PRUSSIA
(DEKALB PIKE)
TURNPIKE
MAYBAR
north
0
360 ft
1
2
3
4
6
7
10
11
12
13
16
20
25
32
34
36
39
41
43
44
52

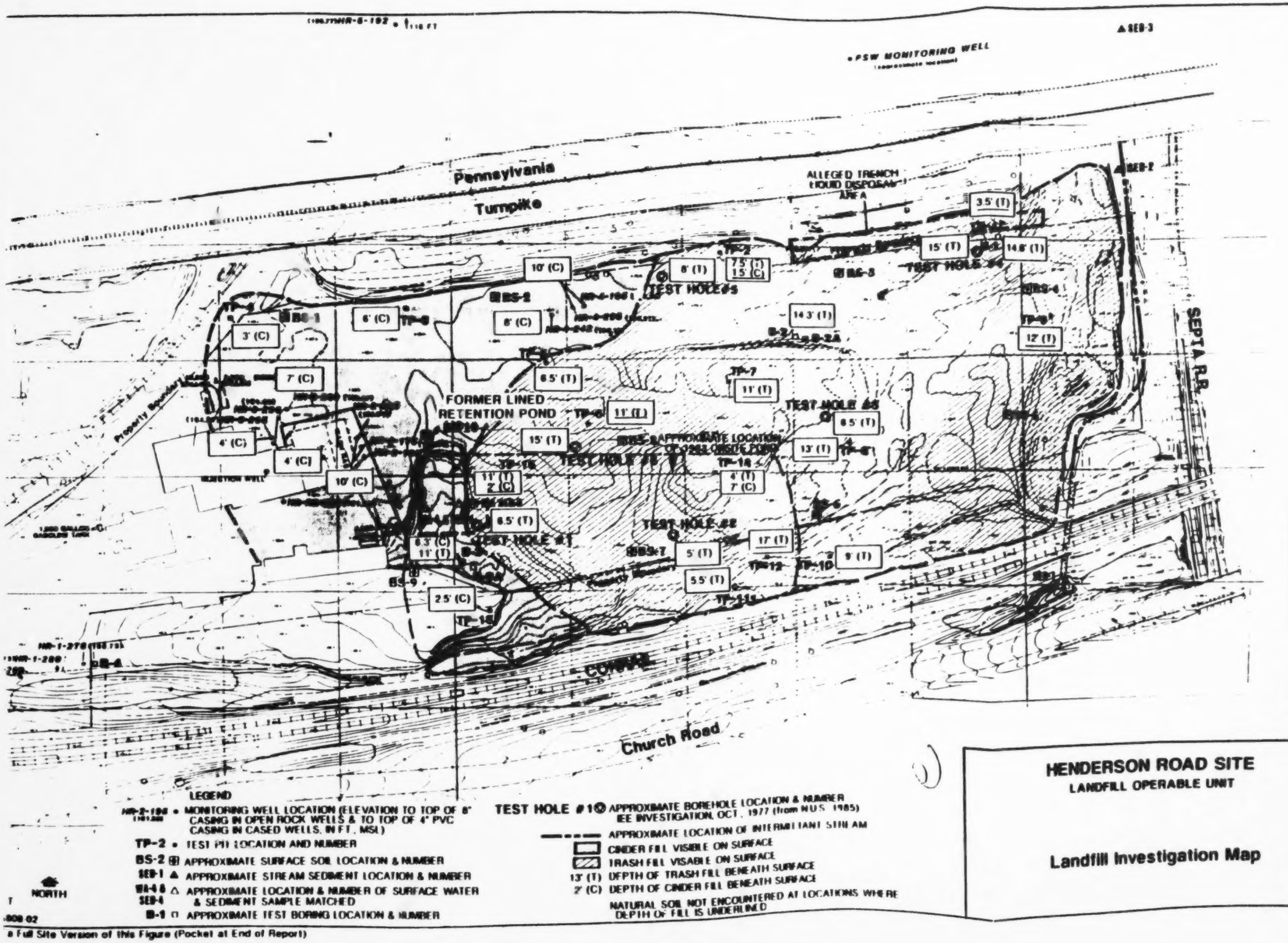
PROPERTY LEGEND	
01	Ph Suburban
03	Glasgow Quarry Inc
04	Ph Suburban
06	PECO
07	Cumberland CIDA
10	Wm. O'Hara
11	O'Hara Sanitation
12	Pennsylvania Rail Road
13	Glasgow Quarry, Inc.
16	Chester Valley RR
19	Buck, Robert & The August
20	Wm O'Hara Jr
25	Wm O'Hara Jr
32	Pyrolas Gas Corp
33	Kirk & Helen Anderson
34	MCIDA c/o 334 Realty (Hendren)
36	T Baird McIlvain Co
39	Bernard & Ellen Gerben
41	Suzanne & Robert Lehman
43	Montgomery CIDA
44	Joseph M & Elizabeth J Flynn, Jr
46	Mellon Bank Na Trustee c/o Oberman Rebman Maxwell
47	Ph Suburban
52	Mellon Bank Na Trustee c/o Oberman Rebman Maxwell
53	Wm & Betty O'Hara
55	300 S Hend Dagit Realty
56	Wm & Betty O'Hara

SOURCE Upper Merion Township Block No 71

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

Site Area Parcel Map

Reproduced from best available copy.


HR-5-192
PSW MONITORING WELL
SED-3
SED-2
Pennsylvania Turnpike
ALLEGED TRENCH LIQUID DISPOSAL AREA
SEPTA R.R.
Property Boundary
FORMER LINED RETENTION POND
TEST HOLE #5
TEST HOLE #4
TEST HOLE #3
TEST HOLE #2
TEST HOLE #1
TEST HOLE #6
APPROXIMATE LOCATION OF ONSITE POND
BS-1
BS-2
BS-3
BS-4
BS-7
BS-9
TP-2
TP-7
TP-10
TP-12
TP-13
TP-14
TP-15
TP-18
B-2A
3.5' (T)
15' (T)
14.8' (T)
12' (T)
10' (C)
8' (T)
7.5' (T)
15' (C)
14.3' (T)
3' (C)
6' (C)
8' (C)
7' (C)
6.5' (T)
11' (T)
8.5' (T)
13' (T)
4' (C)
4' (C)
10' (C)
15' (T)
11' (T)
2' (C)
4' (T)
7' (C)
6.5' (T)
6.3' (C)
11' (T)
17' (T)
5' (T)
9' (T)
5.5' (T)
2.5' (C)
HR-1-278
CONRAIL
Church Road
LEGEND
HR-2-190 • MONITORING WELL LOCATION (ELEVATION TO TOP OF 8" CASING IN OPEN ROCK WELLS & TO TOP OF 4" PVC CASING IN CASED WELLS, IN FT. MSL)
TP-2 • TEST PIT LOCATION AND NUMBER
BS-2 ⊞ APPROXIMATE SURFACE SOIL LOCATION & NUMBER
SED-1 ▲ APPROXIMATE STREAM SEDIMENT LOCATION & NUMBER
WA-4 & SED-4 △ APPROXIMATE LOCATION & NUMBER OF SURFACE WATER & SEDIMENT SAMPLE MATCHED
B-1 □ APPROXIMATE TEST BORING LOCATION & NUMBER
TEST HOLE #1 ⊗ APPROXIMATE BOREHOLE LOCATION & NUMBER IEE INVESTIGATION, OCT., 1977 (from NUS 1985)
APPROXIMATE LOCATION OF INTERMITTANT STREAM
☐ CINDER FILL VISIBLE ON SURFACE
▨ TRASH FILL VISABLE ON SURFACE
13' (T) DEPTH OF TRASH FILL BENEATH SURFACE
2' (C) DEPTH OF CINDER FILL BENEATH SURFACE
NATURAL SOIL NOT ENCOUNTERED AT LOCATIONS WHERE DEPTH OF FILL IS UNDERLINED
NORTH
008-02

a Full Site Version of this Figure (Pocket at End of Report)

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

Landfill Investigation Map

EXHIBIT 4

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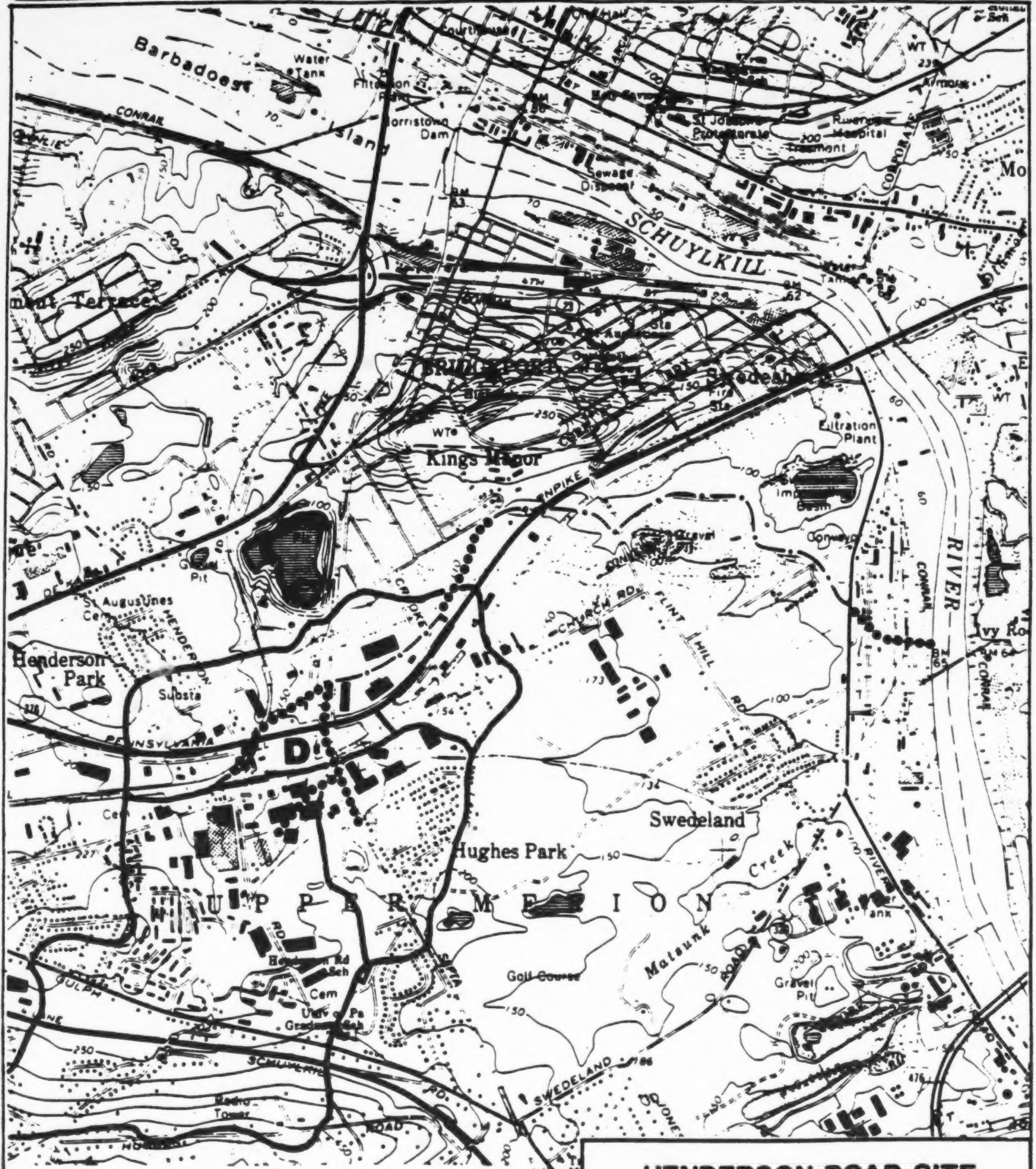
BCM

EXHIBIT 5



Barbadoes Island
Water Tank
Filtration Plant
Norristown Dam
CONRAIL
Courthouse
St Joseph's Protectorate
Riverside Hospital
Tremont
Sewage Disposal
SCHUYLKILL
RIVER
Bridgeport
Swedeland
Kings Manor
Fire Sta
Filtration Plant
Impounding Basin
Conveyor
Gravel Pit
PIKE
Gravel Pit
St Augustines Cem
Henderson Park
HENDERSON RD
Substa
PENNSYLVANIA
D
CHURCH RD
FLINT HILL RD
Cem
Hughes Park
Swedeland
UPPER MERION
Matsunk Creek
RIVER RD
Golf Course
Henderson Rd Sch
Cem
Univ of Pa Graduate Sch
GULPH
SCHUYLKILL
Radio Tower
SWEDELAND RD
Gravel Pit
Tank
Ivy Rock
CONRAIL

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

Watershed Map

LEGEND

●●●●●●● Location of Ephemeral Stream (Approximate)

—·—·— Location of Ephemeral Stream

D - Watershed in which Henderson Road site is located

SOURCE: U.S.G.S. Topo Quad: Norristown, PA (1983)

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0 2000 Ft.

N

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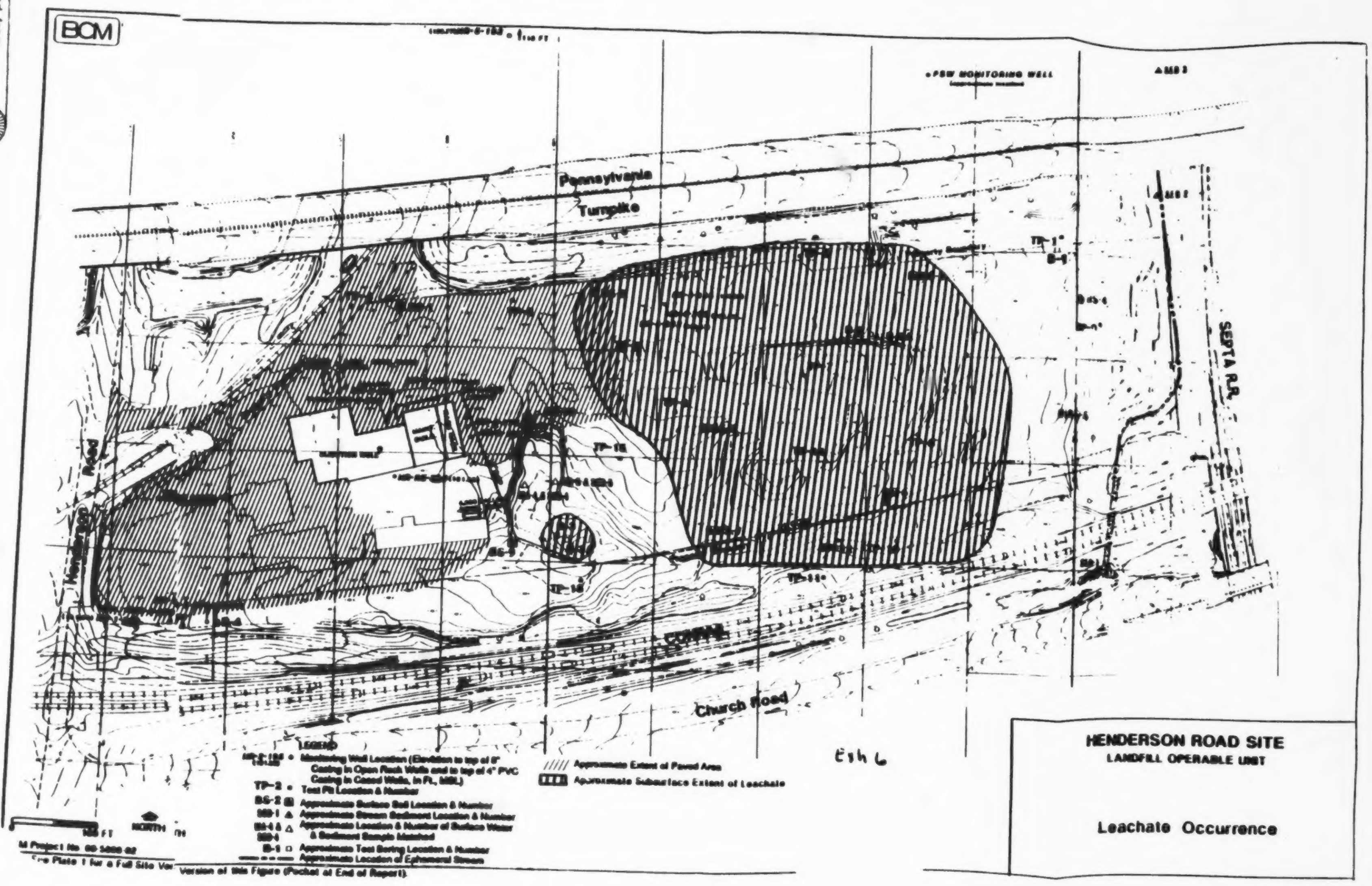
EXHIBIT 6


BCM
Pennsylvania Turnpike
SEPTA R.R.
Church Road
Henderson Road
PSW MONITORING WELL
TP-1
TP-15
TP-16
LEGEND
TP-2 • Test Pit Location & Number
Monitoring Well Location (Elevation to top of 8" Casing in Open Rock Wells and to top of 4" PVC Casing in Cased Wells, in Ft., MSL)
BS-2 Approximate Surface Soil Location & Number
Approximate Stream Sediment Location & Number
Approximate Location & Number of Surface Water & Sediment Sample Matched
B-1 □ Approximate Test Boring Location & Number
Approximate Location of Ephemeral Stream
Approximate Extent of Paved Area
Approximate Subsurface Extent of Leachate
NORTH
FT
M Project No. 00-5000-02
See Plate 1 for a Full Size Version of this Figure (Pocket at End of Report).

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

Leachate Occurrence

Exh 6

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EXHIBIT 7

SUMMARY OF ANALYTICAL RESULTS
DECEMBER 1985 AND JULY 1986 SURFACE SOIL AND SEDIMENT SAMPLES

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

LABORATORY ID:	N521909	N521910	N521911	N521912	N521913	N521914	N521915	N521916
SAMPLE DATE:	12/12/85	12/12/85	12/12/85	12/12/85	12/12/85	12/12/85	12/12/85	12/12/85
SAMPLE NAME:	BS1	BS2	BS3	BS4	BS5	BS6	BS7	BS8
SAMPLE TYPE:	SS/CINDER	SS/CINDER	SS/TRASH	SS/TRASH	SS/TRASH	SS/TRASH	SS/TRASH	SS/TRASH
Parameter (Units)								
Volatile Compounds (ug/kg)								
Acetone	NT	NT	NT	NT	NT	NT	NT	NT
Benzene	<10	<10	<10	<10	<10	<10	<10	<10
Carbon Tetrachloride	<10	<10	<10	<10	<10	<10	<10	<10
Chlorobenzene	110	60	670	250	<10	170	<10	370
1,2-Dichloroethane	<10	<10	<10	<10	<10	<10	<10	<10
Cis-1,3-Dichloropropene	<10	<10	<10	<10	<10	<10	<10	<10
Ethylbenzene	<10	<10	<10	<10	<10	<10	<10	<10
Methylene Chloride	100	80	70	50	<10	30	50	<10
Tetrachloroethene (PCE)	300	3,760	70	<10	<10	<10	<10	<10
Toluene	200	110	100	20	<10	40	170	120
1,1,1-Trichloroethane	<10	40	<10	<10	<10	<10	10	<10
Trichloroethene (TCE)	<10	50	<10	<10	<10	<10	<10	<10
Trichlorofluoromethane	60	120	360	40	<10	500	540	<10
TOTAL VOLATILES DETECTED	770	4,220	1,270	360	ND	740	770	490
Semivolatile Compounds (ug/kg)								
Acenaphthene	NT	NT	NT	NT	NT	NT	NT	NT
*Anthracene	NT	NT	NT	NT	NT	NT	NT	NT
Benzidine	NT	NT	NT	NT	NT	NT	NT	NT
*Benzo(a)Anthracene	NT	NT	NT	NT	NT	NT	NT	NT
*Benzo(a)Pyrene	NT	NT	NT	NT	NT	NT	NT	NT
*Benzo(b)Fluoranthene	NT	NT	NT	NT	NT	NT	NT	NT
*Benzo(k)Fluoranthene	NT	NT	NT	NT	NT	NT	NT	NT
*Benzo(g,h,i)Perlyene	NT	NT	NT	NT	NT	NT	NT	NT
Bis(2-Chloroethyl)Ether	NT	NT	NT	NT	NT	NT	NT	NT
Bis(2-Ethylhexyl)Phthalate	NT	NT	NT	NT	NT	NT	NT	NT
Butyl Benzyl Phthalate	NT	NT	NT	NT	NT	NT	NT	NT
*Chrysene	NT	NT	NT	NT	NT	NT	NT	NT
*Dibenzo(a,h)Anthracene	NT	NT	NT	NT	NT	NT	NT	NT
Dibenzofuran	NT	NT	NT	NT	NT	NT	NT	NT
*Fluoranthene	NT	NT	NT	NT	NT	NT	NT	NT
*Fluorene	NT	NT	NT	NT	NT	NT	NT	NT
*Indeno(1,2,3-cd)Pyrene	NT	NT	NT	NT	NT	NT	NT	NT
2-Methylnaphthalene	NT	NT	NT	NT	NT	NT	NT	NT
*Naphthalene	NT	NT	NT	NT	NT	NT	NT	NT
Phenanthrene	NT	NT	NT	NT	NT	NT	NT	NT
*Pyrene	NT	NT	NT	NT	NT	NT	NT	NT
Pesticides and PCBs (ug/kg)								
Aldrin	NT	NT	NT	NT	NT	NT	NT	NT
alpha-BHC	NT	NT	NT	NT	NT	NT	NT	NT
delta-BHC	NT	NT	NT	NT	NT	NT	NT	NT
4,4'-DDT	NT	NT	NT	NT	NT	NT	NT	NT
Dieldrin	NT	NT	NT	NT	NT	NT	NT	NT
Heptachlor	NT	NT	NT	NT	NT	NT	NT	NT
Inorganic Compounds (mg/kg)								
Antimony	NT	NT	NT	NT	NT	NT	NT	NT
Arsenic	NT	NT	NT	NT	NT	NT	NT	NT
Beryllium	NT	NT	NT	NT	NT	NT	NT	NT
Cadmium	NT	NT	NT	NT	NT	NT	NT	NT
Chromium	NT	NT	NT	NT	NT	NT	NT	NT
Copper	NT	NT	NT	NT	NT	NT	NT	NT
Cyanide	NT	NT	NT	NT	NT	NT	NT	NT
Lead	NT	NT	NT	NT	NT	NT	NT	NT
Mercury	NT	NT	NT	NT	NT	NT	NT	NT
Nickel	NT	NT	NT	NT	NT	NT	NT	NT
Thallium	NT	NT	NT	NT	NT	NT	NT	NT
Zinc	NT	NT	NT	NT	NT	NT	NT	NT
Total Phenolics (mg/kg)	NT	NT	NT	NT	NT	NT	NT	NT

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* PAH included in total PAH values for Figures 4-1, 4-2, and 4-3
NT Not tested as part of this study
SS Surface Soil

Source: BCM Engineers (BCM Project No. 00-5808-02)

EXHIBIT 7 (cont)

LABORATORY ID:	N521917	N521918	N521921	613326	613327	613328	522399	522400
SAMPLE DATE:	12/12/85	12/12/85	12/12/85	07/18/86	07/18/86	07/18/86	12/19/85	12/19/85
SAMPLE NAME:	BS9	BS10	BS COMP	SED-1	SED-2	SED-3	SED-4	SED-5
SAMPLE DESCRIPTION:	SS/TRASH	SS/CINDER		STREAM SEDIMENT	STREAM SEDIMENT	STREAM SEDIMENT	POND SEDIMENT	POND SEDIMENT
Parameter (Units)								
Volatile Compounds (ug/kg)								
Acetone	NT	NT	NT	<12.0	<12.0	9.1	NT	NT
Benzene	<10	<10	NT	<6.0	<5.9	<5.5	100	150
Carbon Tetrachloride	<10	<10	NT	<6.0	<5.9	<5.5	<10	20
Chlorobenzene	<10	<10	NT	<6.0	<5.9	<5.5	<10	<10
1,2-Dichloroethane	<10	<10	NT	<6.0	<5.9	<5.5	<10	9,110
Cis-1,3-Dichloropropene	<10	<10	NT	<6.0	<5.9	<5.5	<10	50
Ethylbenzene	<10	<10	NT	<6.0	<5.9	<5.5	480	430
Methylene Chloride	50	20	NT	37.0	50.0	39.0	<10	<10
Tetrachloroethene (PCE)	140	<10	NT	<6.0	<5.9	<5.5	<10	<10
Toluene	120	30	NT	<6.0	<5.9	<5.5	2,570	4,650
1,1,1-Trichloroethane	<10	<10	NT	<6.0	<5.9	<5.5	<10	<10
Trichloroethene (TCE)	<10	<10	NT	<6.0	<5.9	<5.5	<10	<10
Trichlorofluoromethane	150	40	NT	NT	NT	NT	<10	<10
TOTAL VOLATILES DETECTED	460	90	NT	37.0	50.0	48.1	3,150	14,410
Semivolatile Compounds (ug/kg)								
Acenaphthene	NT	NT	1,800	220	250	250	<1,000	<1,000
*Anthracene	NT	NT	2,300	590	610	550	<1,000	<1,000
Benzidine	NT	NT	<1,600	NT	NT	NT	7,300	<1,000
*Benzo(a)Anthracene	NT	NT	6,500	1,300	1,500	1,200	<1,000	<1,000
*Benzo(a)Pyrene	NT	NT	5,500	1,300	1,400	1,200	<1,000	<1,000
*Benzo(b)Fluoranthene	NT	NT	10,000	2,300	2,900	2,300	6,800	<1,000
*Benzo(k)Fluoranthene	NT	NT	10,000	2,300	2,900	2,300	<1,000	<1,000
*Benzo(g,h,i)Perlyene	NT	NT	<4,000	690	570	740	<1,000	3,000
Bis(2-Chloroethyl)Ether	NT	NT	<1,600	<820	<410	<750	62,000	<1,000
Bis(2-Ethylhexyl)Phthalate	NT	NT	3,300	<820	510	180	27,000	<1,000
Butyl Benzyl Phthalate	NT	NT	<1,600	<820	230	<750	<1,000	<1,000
*Chrysene	NT	NT	6,000	1,600	1,800	1,400	19,000	<1,000
*Dibenzo(a,h)Anthracene	NT	NT	<4,000	<820	<410	260	<1,000	<1,000
Dibenzofuran	NT	NT	NT	130	140	160	NT	NT
*Fluoranthene	NT	NT	13,000	2,800	4,400	2,400	13,000	7,400
*Fluorene	NT	NT	1,600	190	250	260	<1,000	<1,000
*Indeno(1,2,3-cd)Pyrene	NT	NT	<4000	670	610	660	<1,000	<1,000
2-Methylnaphthalene	NT	NT	NT	<820.0	49	<750	NT	NT
*Naphthalene	NT	NT	<1,600	<820.0	49	<750	<1,000	<1,000
Phenanthrene	NT	NT	14,000	2,400	2,900	2,500	11,000	<1,000
*Pyrene	NT	NT	9,400	3,500	2,500	3,300	7,300	<1,000
TOTAL SEMIVOLATILES DETECTED			83,400	19,990	23,568	19,660	153,400	10,400
Pesticides and PCBs (ug/kg)								
Aldrin	NT	NT	NT	<10.0	<10.0	<10.0	2.1	2.5
alpha-BHC	NT	NT	NT	<10.0	19.0	<10.0	4.8	14.0
delta-BHC	NT	NT	NT	15.0	53.0	<10.0	<1.0	<1.0
4,4'-DDT	NT	NT	NT	<10.0	<10.0	<10.0	37.0	20.0
Dieldrin	NT	NT	NT	<10.0	<10.0	<10.0	3.9	2.4
Heptachlor	NT	NT	NT	<10.0	<10.0	<10.0	19.0	<1.0
Inorganic Compounds (mg/kg)								
Antimony	NT	NT	<0.02	<0.02	<0.02	<0.02	0.12	<0.02
Arsenic	NT	NT	0.03	0.55	0.80	<0.04	0.165	0.371
Beryllium	NT	NT	<0.1	0.25	0.40	0.41	<0.1	<0.1
Cadmium	NT	NT	0.9	<0.10	1.61	1.55	0.62	0.83
Chromium	NT	NT	3.0	6.71	14.10	11.30	5.20	59.80
Copper	NT	NT	2.39	10.00	29.50	10.50	<0.30	67.80
Cyanide	NT	NT	0.187	NT	NT	NT	<0.16	<0.16
Lead	NT	NT	9.94	25.80	43.10	33.50	11.00	156.00
Mercury	NT	NT	0.45	<0.10	0.093	0.093	0.20	0.15
Nickel	NT	NT	7.74	4.44	6.55	6.55	26.10	39.70
Thallium	NT	NT	<0.02	5.59	5.59	5.59	4.85	3.66
Zinc	NT	NT	129.0	33.60	66.00	59.00	111.00	174.00
Total Phenolics (mg/kg)	NT	NT	0.231	NT	NT	NT	<0.04	<0.04

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* PAH included in total PAH values for Figures 4-1, 4-2, and 4-3
NT Not tested as part of this study
SS Surface Soil

Source: BCM Engineers (BCM Project No. 00-5808-02)

EXHIBIT 3

SUMMARY OF ANALYTICAL RESULTS
TEST PIT SAMPLES

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

LABORATORY ID: SAMPLE DATE: SAMPLE NAME: SAMPLE TYPE:	608988 05/07/86 TP-2 CINDER FILL	608811 05/07/86 TP-5 NATURAL SOIL	608970 05/08/86 TP-10 NATURAL SOIL	608989 05/08/86 TP-11 NATURAL SOIL	608990 05/09/86 TP-14 NATURAL SOIL	608995 05/09/86 TP-12 LEACHATE**	608996 05/09/86 TP-14 LEACHATE**
Parameter (Units)							
Volatile Compounds (ug/kg)							
Benzene	<10.0	40.0	<10.0	<10.0	410.0	<1.0	152.0
Chlorobenzene	<10.0	<10.0	<10.0	<10.0	290.0	<1.0	<1.0
Chloroform	<10.0	70.0	<10.0	<10.0	<10.0	<1.0	30.2
Ethylbenzene	330.0	10.0	<10.0	1,740.0	3,920.0	52.6	39.0
Methylene Chloride	20.0	<10.0	<10.0	20.0	20.0	<1.0	<1.0
Tetrachloroethene (PCE)	<10.0	<10.0	<10.0	<10.0	4,100.0	<1.0	34.9
Toluene	130.0	40.0	40.0	<10.0	3,770.0	27.3	123.0
Trans-1,3-Dichloropropene	<10.0	<10.0	<10.0	<10.0	<10.0	<1.0	10.3
Trichloroethene (TCE)	<10.0	<10.0	<10.0	<10.0	2,850.0	<1.0	14.1
TOTAL VOLATILE COMPOUNDS	480.0	160.0	40.0	1,760.0	15,360.0	79.9	403.5
Semivolatile Compounds (ug/kg)							
*Benzo(k)Fluoranthene	<1,000.0	<1,000.0	<1,000.0	<1,000.0	<1,000.0	23.0	35.0
Bis(2-Chloroethoxy)Methane	<1,000.0	<1,000.0	<1,000.0	<1,000.0	<1,000.0	26.0	60.0
Bis(2-Chloroethyl)Ether	<1,000.0	<1,000.0	<1,000.0	<1,000.0	7,900.0	17.0	92.0
Bis(2-Ethylhexyl)Phthalate	26,000.0	<1,000.0	<1,000.0	<1,000.0	4,000.0	7.4	24.0
Butyl Benzyl Phthalate	<1,000.0	<1,000.0	<1,000.0	<1,000.0	38,000.0	25.0	34.0
Di-n-Butyl Phthalate	<1,000.0	<1,000.0	<1,000.0	<1,000.0	6,000.0	<5.0	8.2
1,2-Dichlorobenzene	<10.0	<10.0	<10.0	<10.0	18,000.0	<1.0	<1.0
1,3-Dichlorobenzene	<10.0	<10.0	<10.0	<10.0	41,000.0	<1.0	<1.0
1,4-Dichlorobenzene	30.0	<10.0	<10.0	<10.0	<10.0	<1.0	<1.0
2,4-Dimethylphenol	<1,000.0	<5.0	<1,000.0	<1,000.0	<1,000.0	<5.0	20.0
2,6-Dinitrotoluene	32,000.0	<1,000.0	<1,000.0	<1,000.0	<1,000.0	<5.0	<5.0
*Fluoranthene	<1,000.0	<1,000.0	<1,000.0	2,200.0	<1,000.0	104.0	183.0
*Fluorene	<1,000.0	<1,000.0	<1,000.0	<1,000.0	<1,000.0	16.0	<5.0
Hexachlorobenzene	69,000.0	<1,000.0	<1,000.0	<1,000.0	14,000.0	16.0	<5.0
Hexachlorobutadiene	56,000.0	<1,000.0	<1,000.0	<1,000.0	26,000.0	30.0	35.0
Hexachloroethane	<1,000.0	<1,000.0	<1,000.0	<1,000.0	116,000.0	<5.0	23.0
*Naphthalene	<1,000.0	<1,000.0	<1,000.0	<1,000.0	<1,000.0	24.0	76.0
Nitrobenzene	<1,000.0	<1,000.0	<1,000.0	<1,000.0	<1,000.0	52.0	16.0
N-Nitrosodimethylamine	<1,000.0	<1,000.0	<1,000.0	<1,000.0	<1,000.0	<5.0	135.0
N-Nitrosodi-n-Propylamine	<1,000.0	<1,000.0	<1,000.0	<1,000.0	24,000.0	<5.0	<5.0
Phenol	<1,000.0	<5.0	<1,000.0	<1,000.0	<1,000.0	<5.0	19.8
*Pyrene	<1,000.0	<1,000.0	<1,000.0	<1,000.0	1,400.0	<5.0	<5.0
1,2,4-Trichlorobenzene	<1,000.0	<1,000.0	<1,000.0	<1,000.0	<1,000.0	<5.0	11.0
TOTAL SEMIVOLATILE COMPOUNDS	183,030.0	ND	ND	2,200.0	296,300.0	340.4	772.0
Pesticides and PCBs (ug/kg)							
Aldrin	<1.0	<0.1	<0.1	<0.1	<1.0	16.0	<0.1
delta-BHC	<1.0	<0.1	<0.1	<0.1	<1.0	9.1	<0.1
Chlordane	<1.0	<0.1	<0.1	134.0	<1.0	<0.1	<0.1
4,4'-DDT	<1.0	<0.1	<0.1	<0.1	<1.0	3.1	3.2
PCB-1248	8,300.0	<0.5	<0.5	<0.5	<5.0	<0.5	<0.5
PCB-1254	5,500.0	<0.5	<0.5	<0.5	<5.0	<0.5	<0.5
Inorganic Compounds (mg/kg)							
Antimony	<0.02	<0.02	<0.02	<0.02	<0.02	0.008	0.003
Arsenic	0.122	0.88	1.97	1.19	2.001	<0.002	0.003
Beryllium	4.75	4.05	11.0	8.9	9.2	<0.01	<0.01
Cadmium	1.65	0.7	2.5	2.5	2.2	<0.01	<0.01
Chromium	198.0	5.4	12.5	26.0	18.5	<0.01	0.01
Copper	106.0	4.03	15.8	9.62	100.0	<0.02	<0.020
Cyanide	0.305	0.118	0.087	<0.16	<0.16	0.02	0.08
Lead	72.200	5.06	19.6	11.5	10.6	<0.002	<0.002
Mercury	0.3	0.1	0.7	0.2	0.2	<0.0002	<0.000
Nickel	92.5	3.89	13.1	8.9	19.3	<0.1	<0.1
Silver	1.4	<0.2	0.3	0.55	0.3	<0.01	<0.01
Thallium	9.32	<3.0	<3.0	5.0	3.0	<0.3	<0.3
Zinc	335.0	7.5	62.0	33.0	46.5	0.044	0.04
Total Phenolics (mg/kg)	<0.04	<0.13	<0.13	<0.04	<0.04	0.195	0.63

---

* PAH included in total PAH values for Figures 4-1, 4-2, and 4-3

** Leachate analytical results recorded in mg/l for inorganic compounds and total phenolics and in ug/l for all other results

ND None detected

Source: BCM Engineers (BCM Project No. 00-5808-02)

EXHIBIT 9

SUMMARY OF ANALYTICAL RESULTS
EPA ANALYSES OF NOVEMBER 1987 SOIL SAMPLES

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

EPA LABORATORY ID:	8711120-01 MCX871	871120-02 MCX872	871123-01 MCR221	871123-02 MCR197	871125-05 MCR228	871124-01 MCR222
SAMPLE DATE:	11/19/87	11/19/87	11/20/87	11/20/87	11/24/87	11/23/87
EPA SAMPLE NAME:	BH1A	BH1B	BH2A	BH2B	BH6A	BH3A
SAMPLE LOCATION:	B-1(14-15.5)	B-1(30-31.5)	B-2(14.5-16)	B-2(30-31.5)	B-2A(40-41.5)	B-3(19-20.5)
SAMPLE TYPE:	Natural Soil	Natural Soil	Natural Soil	Natural Soil	Natural Soil	Natural Soil
Parameter (Units)						
Volatile Compounds**	ND	ND	ND	ND	ND	ND
Semivolatile Compounds*** (ug/kg)						
4-Methylphenol	<830	<820	<830	<830	<1,000	20 J
Diethylphthalate	<830	<820	<830	<830	<1,000	50
Phenanthrene	30 J	<820	20 J A	<830	<1,000	50
*Anthracene	<830	<820	<830	<830	<1,000	5 A
Di-n-butylphthalate	<830	NC	<830	<830	NC	NC
*Fluoranthene	60	<820	20 J A	<830	<1,000	40
*Pyrene	50	<820	30 J A	<830	<1,000	20
Butylbenzylphthalate	<830	<820	<830	<830	<1,000	<990
*Benzo(a)Anthracene	<830	<820	<830	<830	<1,000	<990
Bis(2-ethylhexyl)Phthalate	NC	NC	NC	NC	NC	NC
*Chrysene	<830	<820	40 J A	<830	<1,000	<990
Di-n-octylphthalate	<830	NC	<830	NC	<1,000	<990
TOTAL SEMIVOLATILE COMPOUNDS	140	ND	110	ND	ND	185
Pesticides and PCBs (mg/kg)	ND	ND	ND	ND	ND	ND
Inorganic Parameters (mg/kg)						
Aluminum	6,580 J	17,300 J	24,600 J	15,700 J	11,000 J	10,700 J
Antimony	<6.1 R	<6.7	<6.7	<6.6 R	<6.5 R	<6.6 R
Arsenic	<1.6	6.4	6.4	16	16	12
Barium	18 J	50	80	40	66	9.8 J
Beryllium	<1.1	7.4 J	<1.2	2.7 J	6.0	1.8 J
Cadmium	3.2 J	8.6	5.6	7.5	8.1	9.7
Calcium	1,190	1,100	1,610	454 J	730	894
Chromium	9.8	17	35	12	11	17
Cobalt	2.1 J	12 J	6.9	17	30	15
Copper	13 J	40 J	17 J	54 J	47 J	44 J
Cyanide	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2
Iron	14,900	39,800	29,200	38,600	35,200	49,800 J
Lead	10	13 J	23 R	21	18	34
Magnesium	586	1,110	2,780	560	617	564
Manganese	60	718	271	801	1,210	109
Mercury	<0.11	<0.12	<0.12	<0.12	<0.12	<0.12
Nickel	7.5 J	54	22	47	54	32
Potassium	1,400 J	883 J	1,670 J	736 J	721 J	372 J
Selenium	<0.68 UL	<0.76 UL	<0.76 UL	<0.73 UL	<0.72 UL	<0.71 UL
Silver	<1.6	<1.7	<1.7	<1.7	<1.7	<1.7
Sodium	384 J	270 J	493 J	270 J	266 J	252 J
Thallium	<1.6 UL	<1.7 UL	<1.7 UL	<1.7 UL	<1.7 UL	<1.7 UL
Vanadium	15	34	52	28	19	34
Zinc	18	108	54	155	123	94
Tentatively Identified Compounds (mg/kg)						
Hexane, 2,4-Dimethyl-	0.06 A	ND	ND	ND	ND	ND
Octane, 3-Ethyl-2,7-Dimethyl-	0.06 A	ND	ND	ND	ND	ND
Hexadecanoic Acid	0.3	ND	ND	ND	ND	ND
Cyclopropane, Octyl-	0.1	ND	ND	ND	ND	ND
Nonane, 3,7-Dimethyl-	0.08 A	ND	ND	ND	ND	ND
Propanoic Acid, 3,3'-Thiobis- Didodecyl ester	5.2	4.5	3.5	8.4	ND	ND
Pyrrolidine	ND	0.08 A	ND	ND	ND	ND
Aziridine, 1-Propyl-	ND	0.1	ND	ND	ND	ND
2-Propenoic Acid, Octyl Ester	ND	0.3	ND	ND	ND	ND
Hexanedioic Acid, Dioctyl Ester	ND	9.1	3.1	4.4	ND	ND
Octane, 2,4,6-Trimethyl-	ND	0.3 B	0.6 B	ND	ND	ND
Benzene, (1,1-Dimethylethyl)-	ND	ND	0.07 A	ND	ND	ND
Decane, 2,6-Dimethyl-	ND	ND	0.03 A	ND	ND	ND
Decane, 2,5,9-Trimethyl-	ND	ND	0.1	ND	ND	ND
1-Heptanol, 2-Propyl-	ND	ND	0.1	ND	ND	ND
Hydroxylamine, o-Decyl-	ND	ND	0.06 A	ND	ND	ND
1-Decanol, 2-Ethyl-	ND	ND	0.1	ND	ND	ND
3-Hexene, 2,5-Dione-	ND	ND	ND	0.2	ND	ND
2-Pentanol, 2,4-Dimethyl-	ND	ND	ND	0.2	ND	ND
Butane, 1-Chloro-3-Methyl-	ND	ND	ND	0.03 A	ND	ND
Nitric Acid, Nonyl Ester	ND	ND	ND	0.06 A	ND	ND
Undecane	ND	ND	ND	ND	ND	ND
Octane, 2,3,7-Trimethyl-	ND	ND	ND	ND	ND	ND
Decane, 3-Bromo-	ND	ND	ND	ND	ND	ND
Nonane, 2-6-Dimethyl-	ND	ND	ND	ND	ND	ND
1H-Indene, Octahydro-2,2,4,4,7,7-Hexamethyl-, trans-	ND	ND	ND	ND	ND	ND
Undecane, 4,6-Dimethyl-	ND	ND	ND	ND	ND	ND
Nonane, 3,7-Dimethyl-	ND	ND	ND	ND	ND	ND
Dodecane, 2,6,11-Trimethyl-	ND	ND	ND	ND	ND	ND
Undecane, 4,7-Dimethyl-	ND	ND	ND	ND	ND	ND
Dodecane, 2,7,10-Trimethyl-	ND	ND	ND	ND	ND	ND
Unknown	ND	ND	1.2	2.8	ND	ND

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* PAH included in total PAH values for Figures 4-1, 4-2, and 4-3
** Detection limits for volatile compounds ranged from 20 to 40 ug/kg for samples analyzed using the standard CLP method and from 10,000 to 20,000 ug/kg for samples analyzed using modified sampling and analysis for the methanol method
*** Detection limits for semivolatile compounds were computed by multiplying the nominal quantitation limit for the compound by the sample specific dilution/concentration ratio
A Result also listed as trace
B Tentatively identified compound listed more than once; highest detected concentration is reported
J For organic compounds: Estimated quantity; concentration below the level for accurate quantitation
For inorganic compounds: Compound present; reported concentration may not be accurate or precise
NC Not detected after correction for laboratory blanks
ND Not detected
R Unreliable result; compound may or may not be present
UL Not detected; quantitation limit is probably higher
Sample Location = Boring number (sample depth in feet below surface)

Sources: EPA Region III Central Regional Laboratory
Compiled by: BCM Engineers (BCM Project No. [illegible])

RESPONSIVENESS SUMMARY
HENDERSON ROAD SITE LANDFILL OPERABLE UNIT

EPA made the draft RI/FS, which was prepared by the respondents under the 1985 Administrative Order on Consent, and Proposed Plan available to the public for review on June 12, 1989. Comments were received from the public through July 12, 1989.

EPA provided preliminary comments to the respondents on the draft RI/FS on June 9, 1989. EPA provided final comments on the draft RI/FS, which included consideration of public comments received, to the respondents on August 18, 1989. A revised, final RI/FS was due to be submitted to EPA on September 18, 1989 but none has been received to date. Consequently, this ROD is being prepared without a final RI/FS.

This Responsiveness Summary will provide EPA's response to public comments received.

I. Comments Submitted by Philadelphia Suburban Water Company, July 10, 1989

Comment: Landfilling has continued past 1984.

Response: Determination whether landfilling has continued past 1984 will not affect the remedy. Certainly, landfilling during RD/RA would be inconsistent with remedial objectives. PA DER has reported that the landfilling aspect of a September, 1988, PA DER order is under appeal.

Comment: Traffic to be permitted on-site should be spelled out.

Response: Activities determined to be inconsistent with the selected remedy will be controlled as part of the "institutional controls" component of the remedy. As stated in Section VII.B.8 of this ROD, "Any activities that would jeopardize the integrity of the cap, such as truck movement on the cap, or interfere with the leachate collectiion system would be prohibited." Specific weight, volume and location of traffic that would be allowed will be addressed during Remedial Design.

Comment: EPA influence on permit approvals for relocation of trash transfer facility and potential delays in LOU RD/RA pending issuance of such permits.

Response: The EPA Superfund Remedial Branch has not participated in any discussions with DER or Upper Merion Township regarding the permit and zoning applications for trash recycling facility north of Turnpike property. As continued trash transfer operations at the Henderson Road site are considered inconsistent with the selected remedy, these activities will not be allowed on-site once Remedial Action is underway. No delays related to the facility north of the Turnpike are anticipated at this time.

Comment: Need for EPA oversight during RD/RA.

Response: Should RD/RA be conducted by potentially responsible parties, EPA will maintain appropriate oversight of all RD/RA.

Comment: Qualifications of RemTech.

Response: A contractor has not been selected for RD/RA of the LOU. Should a RD/RA proceed as "enforcement lead", the qualifications of the Potentiallly Responsible Parties performing the work would need to be approved by EPA.

Comment: Sinkholes do exist in the vicinity of the site.

Response: The additional information concerning sinkhole activity in the immediate area of the site is noted. EPA has requested, as part of EPA's comments on the draft RI, that the statement in the RI should be reworded to reflect thses findings.

Comment: No stream flow measurements were made in Frog Run.

Response: The respondents and EPA made several visits on several times of the year to determine if this stretch of Frog Run had sufficient water to collect a sample. The portion of the stream adjacent to the site remained dry throughout the duration of the RI. Since no channelized flow was observed, stream flow measurements could not be made.

Comment: Runoff and the drainpipe which discharges into Frog Run should have been sampled.

Response: Sufficient runoff from the site to justify the collection of a sample was not observed throughout the duration of the RI. However, EPA has included sufficient funds, in the estimated costs of the selected remedy, to collect and analyze samples of storm water runoff biannually throughout the duration of site remediation, should condidtions change in the future.

Comment: Leachate is likely to be migrating to UMR.

Response: EPA agrees that the landfill leachate is a major concern for the LOU, as it presents the majority of the risk to public health. Based on the RI results, there does not appear to be the impetus for leachate to flow to UMR in the unsaturated zone, and leachate was not observed discharging to Frog Run. Therefore, the major pathway for the leachate to migrate to UMR is through the natural soils (silty clay) and unsaturated bedrock to the saturated zone, where it would flow to UMR. The migration of leachate through the natural soils was modeled during the RI using conservative assumptions, and the results were carried through the Risk Assessment to evaluate the effect on public health. EPA has also included, in the selected remedy, provisions to remove leachate in the "perched" zone and subsequently install a leachate collection system, monitor leachate development and quality in the "perched" zone, and ground water quality in the bedrock, and the contingency to collect and treat contaminated ground water from the bedrock aquifer. The selected remedy provides a sufficient level of investigation and remedial action to address the contaminated leachate associated with the LOU.

Comment: The two soil borings which have been done in this area to date are not adequate for the purpose of determining the risk associated with stopping the cap at the western edge of the water company's easement. Before considering relocation of the water main, a concerted effort should be made to characterize the contamination under and to the east of the water main. PSWC prefers not to move the water main.

Response: EPA agrees that additional characterization is needed in the vicinity of the water main, as part of Remedial Design, to fully address the potential for leakage from the water main and maintenance of the water main to interfere with remedial objectives. In consideration of protection of human health and state acceptance and for costing purposes, movement of the water main to the east, crossing under the Upper Merion Township sewer line, Frog Run, and the SEPTA railroad tracks, then along the eastern side of those tracks to Church Road, then back under the tracks, stream and sewer to reconnect to the main at Church Road, as described in your June 12, 1989 letter to EPA, is included in the selected remedy. However, other engineering options regarding the water main and extent of the cap may be considered during Remedial Design. Providing remedial objectives are met an alternative to moving the water main may be selected during Remedial Design. PA DER will be provided an opportunity to participate in this final decision.

Comment: Glasgow, Inc. may not be using UMR water.

Response: Glasgow Quarry, Inc. is listed in the draft Workplan for RD/RA for the Injection Well Operable Unit as an owner of property potentially affected by the injection well. Institutional controls are planned to be implemented as part of RD/RA for the Injection Well Operable Unit. As appropriate, institutional controls for RD/RA for the LOU will be added.

Comment: The tax parcel map incorrectly identifies William H'Hara Jr. as the owner of parcels 10, 20 and 25.

Response: This comment was included in EPA's comments on the RI/FS.

II. Comments from F. Costanzi, PA DER, dated July 12, 1989

Comment: The distance to UMR is 2,000 feet.

Response: This correction has been made in the ROD.

Comment: DER agrees that a PA cap will meet our standards.

Response: No response needed.

Comment: More emphasis is needed on O'Hara's role in waste disposal operations compared to Ellis Concrete's role.

Response: Section 1 to the ROD summarizes the information known regarding surface waste disposal operations at the site. The Potentially Responsible Parties have not provided records of materials disposed at the site.

Comment: PA DER's Residual Waste regulations, now in draft form, should be available in final form in time to be useful to address remediation in the western portion of the site.

Response: When these regulation are finalized, their applicability, relevance, and appropriateness will be determined. Exhibit 17, which is the same as Table 2-1 to the draft FS, lists these proposed regulations as relevant and appropriate.

Comment: Further characterization on the Turnpike property is necessary in light of the minimal sampling previously conducted. Use of in-situ soils to prevent downward migration is not wholly accepted.

Response: EPA agrees that additional characterization is needed prior to design of a remedy on the Turnpike property. However, excavation and consolidation of shallow soils and fill is expected to be consistent with remedial objectives, will meet Land Ban requirements, and is more cost-effective than incineration. The selected remedy includes, for costing purposes, implementation of runon/ runoff controls, leachate collection, and construction of an asphalt cap over 33,000 square feet of the Turnpike property. Section II.B.8 of this ROD states, "Other appropriate remedial measures on the Turnpike property may be selected during RD to support the remedial objectives for the LOU."

III. Comments Provided from Ragesh Patel, PA DER, dated July 12, 1989

Comment: The cap should meet PA DER requirements.

Response: PA DER will be provided the opportunity to review design plans. EPA expects that state ARARs may be met in final cap design.

Comment: There is no synopsis given for the French drain location, material, etc.

Response: Design of the leachate collection system will occur during Remedial Design, after additional characterization of the low permeability layer of the landfill is completed.

Comment: The retaining wall should be structurally sound and aesthetically acceptable towards the turnpike side. The waste between the retaining wall and the turnpike should be disposed of in a responsible manner.

Response: A retaining wall that is not structurally sound would be inconsistent with remedial objectives. Excavated waste from the Turnpike property will be placed on the Henderson Road site. This is expected to meet RCRA Land Ban requirements.

IV. Comments Provided from John Fabian, PA DER, dated June 5, 1989

Comment: Although water mains are pressurized, a break of even maintenance elsewhere in the system can result in a loss of pressure in this section of the main. Infiltration of leachate through a pipe joint or crack could result.

Response: This consideration will be fully addressed in Remedial Design. Unless an alternative to moving the water main is designed that meets remedial objectives and ARARs, the water main will be moved.

Comment: How does PSWC plan to provide maintenance to this main if it is denied permission to break the solid waste cap in order to gain access to the pipe?

Response: This consideration will be fully addressed in Design.

Comment: Pipe could interfere with leachate collection.

Response: This consideration will be fully addressed in Design.

Comment: A leaking pipe could jeapardize the integrity of the cap.

Response: This consideration will be fully addressed in Design.

Comment: Would PSWC assume liability for spread of contaminants if pipeline ruptures after the RA contractor has left the site?

Response: An acceptable alternative to moving the pipe would need to be based on demonstration that such a release of contaminants from a ruptured water main would not occur. It is possible that PSWC would be provided the opportunity, during Remedial Design, to accept the liability for a ruptured main. This ROD proposes moving the water main, unless an alternative that meets remedial objectives is designed. Therefore, PSWC has not been approached on this issue.

Comment: The following three options may be acceptable:

1. The water main is abandoned and water service is picked up by remaining connections (if they exist).

2. A new water main is constructed around the site.

3. The PSWC ROW is excavated, lined and backfilled thus restoring it to its original condition.

Response: These options will be considered in Remedial Design.

V. Comments Provided from Pennsylvania Turnpike Commission, dated July 11, 1989

Comment: Institutional controls should not hinder future Turnpike expansion.

Response: As stated in Section VII.B.8 of this ROD, "To the maximum extent feasible and cost-effective, ground water and leachate would be recovered and monitoring activities would be conducted off the Turnpike property in order to prevent a conflict between Turnpike expansion and remedial efforts."

After trash and shallow soils are excavated from the Turnpike property, contamination may be left in the vadose zone. Contaminated leachate is likely to be generated on the Turnpike property unless appropriate remedial action is taken. Thus, EPA and the Turnpike Commission will need to work closely together during RD/RA of the LOU and during design and construction of expansion of the Turnpike near the site in order that the Turnpike may be expanded in a manner that is consistent with remedial objectives.

Comment: The Turnpike Commission should be consulted and plans for expansion should be considered prior to determining the actual location of any well to be located on the Turnpike property.

Response: Access agreements would be instituted prior to installation of any well on the Turnpike property. See response above regarding consideration of Turnpike Commission expansion plans.

Comment: The Commission reserves its right to modify final design of a retaining wall.

Response: No legal response is called for. EPA agrees that flexibility is needed at this point regarding design issues.

Comment: The Commission's supplemental study will not be completed until five months after a contract has been executed between the Commission and the contractor.

Response: This scheduling information has been incorporated into the ROD.

Comment: During the discussion between EPA and the Commission prior to the release of the Proposed Plan, it was agreed that there would be no capping upon the Turnpike property.

Response: "Capping" on the Turnpike property as described in the Proposed Plan was intended to mean a technology that would minimize infiltration of water into the subsurface, so that generation of leachate on the Turnpike property would be minimized. The type of cap, whether asphalt, vegetative, or a PA Solid Waste cap along portions of the Turnpike property south of the retaining wall, will be determined in Remedial Design, after the Turnpike property is sufficiently characterized and in full consideration of planned excavation.

VI. Comments Provided on Behalf of Alumax Inc., Childers Products Company, Congoleum Corporation, Sandvik, Inc., Scott Paper Company and the SmithKline Beckman Corporation

Comment: "Respondents" for the RI/FSs for the two operable units are different.

Response: EPA considers all signators to the 1985 Administrative Order on Consent to be bound to completing the RI/FSs for both operable units. The fact that EPA divided the site into two operable units, in order to expedite ground water remediation, does not absolve any signators from their obligations under the Administrative Order.

Comment: Contamination attributable to the LOU differs in type and concentration from the contamination associated with the IWOU. The Proposed Plan ignores that PAHs and aldrin comprise most of the risk and incorrectly concludes that benzene, chloroform, PCE, TCE, 1,3-dichloropropene, hexochlorobenzene and bis(2-chloroethyl)ether represent the major cancer risk from ground water. For non-carcinogenic risk associated with ground water exposure, the analysis is similar.

Response: As stated in the Proposed Plan, EPA combined the PAHs into one category, leaving 19 chemicals of concern. Otherwise, the percentage of ground water chemicals of concern that overlap between the two operable units are generally correct as presented by the Alumax et.al. comments.

In the analysis of risk to ground water that is presented in the Proposed Plan, EPA assumes that chemicals of concern with K_{oc} greater than 10,000 are relatively immobile and are not likely to pose a major threat to ground water. This point is presented in the draft LOU RI on page 4-39.

The more mobile compounds detected in the LOU are similar to the IWOU chemicals of concern. The immobile compounds detected at the LOU are not likely to be observed at significant concentrations in the ground water. This is one reason why distinguishing between different "plumes" (an inaccurate term in this hydrologic regime) may not be possible.

Furthermore, ground water quality below the landfill and other on-site surface sources of contamination has not been monitored as part of the RI. The potential for the LOU to contribute to ground water contamination exists, and the potential for contamination from the LOU and IWOU to overlap and be difficult to distinguish exists. Information gained during recent geophysical logging as part of IWOU Remedial Design further supports EPA's contention that ground water affected by the site may be affected by both operable units.

The Proposed Plan only addresses ground water risks when comparing IWOU and LOU chemicals of concern. EPA anticipates that surface remediation at the LOU (i.e., capping, runon/runoff and erosion controls) may be distinguished from remediation at the IWOU.

Comment: The statement in the Proposed Plan that EPA does not expect to be able to distinguish between the two operable units as to the sources of ground water contamination beneath the site appears to contradict the draft LOU RI and FS.

Response: The draft RI and FS have been disapproved by EPA. See the August 18, 1989 letter from Gerallyn Valls to Robert Buller, in Administrative Record. A revised, final RI/FS was due to EPA on September 18 in response to the comments attached to Ms. Valls' August 18 letter.

Comment: The IWOU RD/RA approved by the Court neither provides for nor anticipates the performance of additional investigations, such as investigation in the western portion of the site. The focus of the unsaturated zone investigation is on contamination associated with the injection well that may be present in the unsaturated zone due to EPA's theory of a well back-up. There does not appear to be any need to consolidate this work with investigation of surface sources of contamination in this area.

Response: EPA is not proposing that the additional characterization for the western portion of the site, presented in this ROD, should be considered (or financially supported) as part of IWOU RD/RA. However, because ground water beneath the western portion of the site may be threatened from either well back-up or surface sources of contamination, it is reasonable to collect information on this portion of the site and evaluate the fate-and-transport to ground water from both potential sources together. This way, one remedy for the unsaturated zone in the western portion of the site may be selected without unnecessary administrative delays.

Comment: The Settling Generators object to any implication in the Proposed Plan that contaminated ground water believed to be associated with the LOU is also attributable to the IWOU, or vice versa.

Response: For the reasons discussed above, ground water in the vicinity of the site is not expected to be distinguished between operable units.

EPA recognizes that Predesign for the IWOU was initiated with the intent of locating on-site monitoring and recovery wells where the greatest contamination is likely to be found from the injection well, i.e., in the western and central portions of the site. Section 2.6.1 of the IWOU SOW states that additional recovery wells will be installed and/or pumping rates will be adjusted to create a suitable cone of depression if contaminated ground water is found to be bypassing the collection system. Thus, it is possible that recovery wells in the central and eastern portion of the site will be needed as part of the IWOU, even though contaminated ground water which may be found in this area may also be affected by the LOU.

However, it is clear that monitoring and recovery wells in the central and eastern portions of the site will be needed to characterize and recover ground water affected by the landfill. Alternative 7, as described in the draft FS, does not adequately address this fact in light of LOU threats to ground water.

Exhibit 20 was developed by EPA to depict some preliminary locations for ground water recovery and monitoring wells to supplement the preliminary locations listed in the IWOU SOW. The number and locations of these wells may be modified during LOU Remedial Design and must be coordinated with the ground water monitoring and recovery planned for the IWOU.

Comment: It is inappropriate fo the FS to address the coordination needed between both operable units without demonstration of a clear connection between the contamination found in both units.

Response: As discussed above, it is reasonable to anticipate that ground water may be affected by both operable units. EPA acknowledges that coordinating ground water RD/RA between both operable units will be complex; this is a major reason why the need for such coordination is emphasized in the ROD.

VII. Comments Submitted on Behalf of O'Hara Sanitation Company, dated July 12, 1989

Comment: Ownership of the site is inaccurately portrayed.

Response: Principal owner is Betty O'Hara, Trustee.

Comment: Loose reference to injection of waste by "O'Hara."

Response: Reference to individuals and/or companies directly involved in waste injection is not included in the ROD.

VIII. Comments Submitted on Behalf of William J. O'Hara, Inc., Estate of William O'Hara, Sr., and Betty E. O'Hara, July 12, 1989

Comment: Respondents do not accept the validity of the "Landfill Operable Unit."

Response: EPA fully considers the Landfill Operable Unit to be part of the site. EPA considers all respondents to the 1985 Administrative Order on Consent to be obligated to complete the RI/FS for the Landfill Operable

Unit. A Compliance Schedule for the LOU RI/FS was initiated under the Administrative Order in a letter, dated November 2, 1987, from Gerallyn Valls to Alan Robinson, and modified in accordance with the terms of the Administrative Order, during the development of the RI/FS.

Comment: Many of the key assumptions and methodologies used in the RI/FS do not represent the independent opinion or findings of BCM.

Response: The utility of preparing an RI/FS is to provide the basis for EPA's selection of a remedy. EPA disapproved the draft RI/FS in August, 1989, for the reasons included in the disapproval letter. The documents listed in the Administrative Record, including those prepared by Camp Dresser & McKee, form the basis for the remedy developed and selected by EPA. Additional oversight costs have been incurred because the information included in the draft RI/FS was insufficient to complete this ROD.

Comment: There is no basis for the need for any ground water monitoring. There is no documentation that the ground water has been contaminated by the LOU or any substances migrating from the LOU.

Response: No ground water monitoring wells considered representative of the LOU have been installed. The Risk Assessment, Fate-and-Transport Assessment, and this ROD all conclude that the LOU is expected to threaten ground water beneath the site and contribute a substantial human health risk.

Comment: Ground water recovery being undertaken as part of IWOU RD/RA will collect leachate migrating from the LOU.

Response: See the first response listed on page 8 to this Responsiveness Summary.

Comment: Institutional controls being implemented under the IWOU will address the ground water component of the LOU.

Response: Since the LOU is considered to contribute to ground water contamination, institutional controls pertaining to ground water remediation are considered to apply to the LOU.

Comment: As discussed in Section VII.B.8 of this ROD, excavation on the Turnpike property prior to capping the Henderson Road site is most cost-effective.

Response: Unless the cap is in place before removing leachate, it would reenter the unit through infiltration of rainfall. It is premature to decide exactly when to implement leachate collection.

Comment: EPA agrees that many concerns related to design of the cap and leachate collection should be left to Remedial Design. However, based EPA's experience in closing other landfills, EPA expects that leachate removal prior to capping would remove leachate from the unit more effectively than after capping. Capping and long-term leachate collection would immediately follow leachate removal so that infiltration would not occur. "Short-term" does not mean "immediate;" leachate collection would occur after the RD/RA Workplan is approved.

Comment: Rapid leachate removal will no more reduce risk than Alternative most concentrated contaminants, because infiltration has occurred over a long period. Because short-term leachate removal is expected to be more effective in reducing leachate than collection of existing leachate after capping, the risk reduction is considered to be relatively significant.

Comment: The Risk Assessment used in the Proposed Plan is not technically supportable.

Response: The Risk Assessment used in this ROD is consistent with the EPA Superfund Public Health Evaluation Manual. However, EPA agrees that the fate and transport of contaminants needs to be carefully considered in assessing risk for this site. Discussions in various sections of this ROD address the complexity of the "true risk."

EPA has concluded, for the reasons set forth in this ROD which include consideration of assumptions used in the risk assessment, conclusions from the Fate-and-Transport Assessment, the contribution from the IWOU, remedy being implemented for the IWOU, and potential release to UMR, that the LOU presents a substantial risk from exposure to ground water and inhalation and ingestion of fugitive dusts. The major chemicals of concern are bis(2-chloroethyl)ether and volatile organics.

Comment: The evidence in the RI/FS clearly proves that Frog Run contamination originates upstream.

Response: While existing data indicates that contamination may originate from upstream, definitive conclusions based on three sediment samples cannot be made. Additional sampling and runon/runoff and erosion controls are needed to meet remedial objectives.

Comment: EPA's comments in the Proposed Plan that the FS does not take into account the complex remediation planned for the IWOU disregards that EPA did not build a mechanism for coordinating the remediation of the site as a whole and the complex remediation planned for the IWOU was not clearly established prior to completion of the draft FS.

Response: The 1985 Administrative Order on Consent provides the mechanism for coordinating remediation between the operable units, since it covers both operable units. The Statement of Work for RD/RA for the IWOU was completed in October, 1988, which was several months befoe completion of the draft FS.

Comment: EPA's comment that Alternatives 1 through 6 do not address ground water that is already contaminated is misleading because it is not reasonable to expect the LOU to be responsible for existing ground water contamination unless it is first established that it is the source of that contamination.

Response: For the reasons set forth in this ROD, EPA considers the LOU to potentially contribute to on-site and downgradient ground water contamination.

EXHIBIT 10

TABLE 4-11

STUDY CHEMICALS, Koc VALUES

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

Chemical	Koc
Benzidine	11
Bis(2-chloroethyl)ether	14
1,2-Dichloroethane	14
Chloroform	58
Benzene	83
Carbon Tetrachloride	110
Trichloroethene	126
Toluene	300
Tetrachloroethene	364
alpha-BHC	3,800
Hexachlorobenzene	3,900
Fluorene	7,300
Heptachlor	12,000
Phenanthrene	14,000
Hexachloroethane	20,000
Hexachlorobutadiene	29,000
Fluoranthene	38,000
Dieldrin	43,000
Aldrin	96,000
Bis(2-ethylhexyl)phthalate	123,027
Chlordane	140,000
DDT	243,000
PCB-1254	530,000
PCB-1248	530,000
Benzo(k)fluoranthene	550,000
Benzo(a)pyrene	1,023,293
Benzo(a)anthracene	1,380,000

Source: BCM Engineers (BCM Project No. 00-5808-02)

ARAR	Specific Type	Legal Citation	Proposed Legal Classification	Explanation of Classification	Applicability to FS Options
Federal (Continued)					
5. Clean Air Act	Contaminant				
a. National Ambient Air Quality Standards (NAAQS)		40 CFR Part 50 (40 CFR Part 61 for Hazardous Air Pollutants)	Applicable or Relevant and Appropriate	Enforceable standards for direct or indirect emissions to the atmosphere	For gas venting, atmospheric emissions during treatment or non-isolation of unit is selected, these regulations may be applicable.
6. Toxic Substances Control Act (TSCA)	Action	40 CFR 761	Relevant and Appropriate	Enforceable regulations for disposal and storage of PCBs	May be relevant and appropriate to regulate disposal of PCBs
a. PCB Spill Cleanup	Action	52 FR 10688	To be Considered	Policy statement establishing spill reporting requirements and cleanup performance standards	To be considered for remediation of PCB contamination
7. Resource Conservation and Recovery Act (RCRA), including "Land Ban" Requirements	Action	40 CFR 264	Relevant and Appropriate	Enforceable regulations for non-CERCLA hazardous waste storage, treatment and disposal sites. SARA exemption from Land Ban requirements for "Superfund" sites until November 8, 1990.	If offsite hazardous waste removal option is selected, RCRA subtitle C is applicable to destination. For onsite disposal option; relevant and appropriate. Also provides guidance on closure options.
8. DOT Rules for Hazardous Materials Transport	Action	49 CFR Parts 107 and 171-179	Applicable	Enforceable regulations for transport of hazardous materials	Applicable if partial or major excavation results in offsite disposal of hazardous wastes.
9. Occupational Health and Safety Act (OSHA)	Action	29 CFR Parts 1904 1910, and 1926	Applicable	Enforceable regulations provides health and safety requirements for onsite workers	Applicable to onsite work performed during implementation of a remedial action.

(Continued)

ARAR	Specific Type	Legal Citation	Proposed Legal Classification	Explanation of Classification	Applicability to Phase 3 FS Options
Pennsylvania					
1. PA Safe Drinking Water Act	Contaminant	PL 206 (1984)	Applicable	Statute corresponding to Federal SDWA to protect public drinking water supplies	May apply to contingent groundwater recovery and treatment.
(a) PA Safe Drinking Water	Contminant	PA Code, Title 25, Chapter 109	Applicable (Future)	When developed, will provide standards for drinking water contaminant levels.	May apply to contingent groundwater recovery and treatment.
2. PA Clean Streams Law	Action	PA Code Title 25, Chapter 5	Applicable	Enforceable law intended to reclaim and restore polluted streams through water quality control.	Applicable if discharges of contaminated water to ephemeral stream is included in remedial action (ground- (water or leachate treatment also stormwater discharges).
(a) General (Provisions)	Action	PA Code Title 25, Chapter 91	Relevant and Appropriate	Establishes procedures and regulatory framework for Clean Streams Law.	Relevant and appropriate for remedial actions involving wastewater discharges.
(b) PA NPDES Rules	Action	PA Code Title 25, Chapter 92	Relevant and Appropriate	State program governing point-source discharges.	Applicable for actions involving discharge of pollutants to surface water (groundwater or leachate treatment also, stormwater discharges).
(c) PA Water Quality Standards	Contaminant	PA Code Title 25, Chapter 93	Applicable	Enforceable standards for waters that are to be protected.	Applicable for actions involving discharge of pollutants to surface water (groundwater or leachate treatment also, stormwater discharges).

(Continued)

ARAR	Specific Type	Legal Citation	Proposed Legal Classification	Explanation of Classification	Applicability to Phase 3 FS Options
Pennsylvania (Continued)					
(d) Municipal Pretreatment Regulations	Action	PA Code Title 25, Chapter 94	Relevant and Appropriate	Enforceable regulations for discharge into publicly owned treatment works (POTW).	Relevant and appropriate for remedial actions involving wastewater discharge to POTW.
(e) PA Wastewater Treatment Regulations (includes PA Toxics Strategy)	Action	PA Code Title 25, Chapter 95	Applicable	Enforceable regulations to maintain water quality through treatment requirements and standards.	Applicable for remedial actions involving discharges to ephemeral stream (from groundwater or leachate treatment).
(f) PA Industrial Waste Treatment Regulations	Action	PA Code Title 25, Chapter 97	Relevant and Appropriate	Enforceable industrial waste treatment requirements and standards.	Relevant and appropriate for remedial actions involving discharges to ephemeral stream (from groundwater or leachate treatment).
(g) PA Special Water Pollution Regulations	Action	PA Code Title 25, Chapter 101	Relevant and Appropriate	Requirements for spill notification and landfill bonding.	Relevant and appropriate for remedial actions involving landfill closure.
3. PA Air Pollution Control Act of 1960 and Air Pollution Control	Contaminant	PL 2119 (1960) PA Code Title 25, Chapters 121-143	Applicable	Enforceable standards which include NAAQS plus 5 additional constituents atmosphere. (Gas venting,	Applicable to remedial actions involving direct or indirect emissions to the leachate treatment excavations, dust emissions.)
4. Pennsylvania Solid Waste	Action	PL 97, Title 35	Applicable	Comprehensive statute governing the transportation, processing, treatment, storage, and disposal of all solid wastes.	Applicable for offsite disposal and onsite closure. Closure plan required for SWMUs.

ARAR	Specific Type	Legal Citation	Proposed Legal Classification	Explanation of Classification	Applicability to Phase 3 FS Options
Pennsylvania (Continued)					
(a) PA Hazardous Waste	Action	PA Code Title 25,	Relevant and Appropriate	Enforceable regulations corresponding to Federal RCRA regulations. Govern the generation, transportation, and disposal of hazardous wastes.	Relevant and appropriate for offsite disposal and waste classification.
(b) Commonwealth Municipal Waste Regulations	Action	PA Code Title 25, Chapters 271-285	Relevant and Appropriate	Enforceable regulations for non-hazardous waste disposal.	Relevant and appropriate for remedial actions which involve the unit as a solid waste landfill and for gas and water quality monitoring. Also provides clsoure standards.
(c) PA Residual Waste Regulations (Proposed)	Action	PA Code Title 25, Chapters 287-289 (Proposed)	Relevant and Appropriate	Enforceable regulations for non-hazardous residual waste disposal, which are presently covered by the Commonwealth Municipal Waste Regulations.	Relevant and appropriate for remedial actions which involve residual wastes (such as cinders).
5. PA Stormwater Management Act	Action	Act No. 167	Applicable	Stormwater runoff control during alterations to site	Applicable for remedial actions that include land disturbance.
6. PA Erosion Control Regulations	Action	PA Code Title 25, Chapter 102	Applicable	Governs erosion and sedimentation control to prevent pollution of surface water	Applicable for remedial actions that include earth-moving capping on waste excavation.
7. PA Hazardous Substances Transportation Regulations	Action	PA Code Title 13 and 15	Applicable	Requirements for transport of hazardous materials	Applicable for remedial actions that involve transportation of hazardous wastes for offsite disposal.
8. PA Floodplain Management Act	Location	PL 851, No. 166	Relevant and Appropriate	Provides for floodplain land-use management.	Relevant and appropriate for remedial actions within floodplain areas.

EXHIBIT 18

RISK CALCULATIONS FOR GROUND WATER ARARs
HENDERSON ROAD LOU ROD

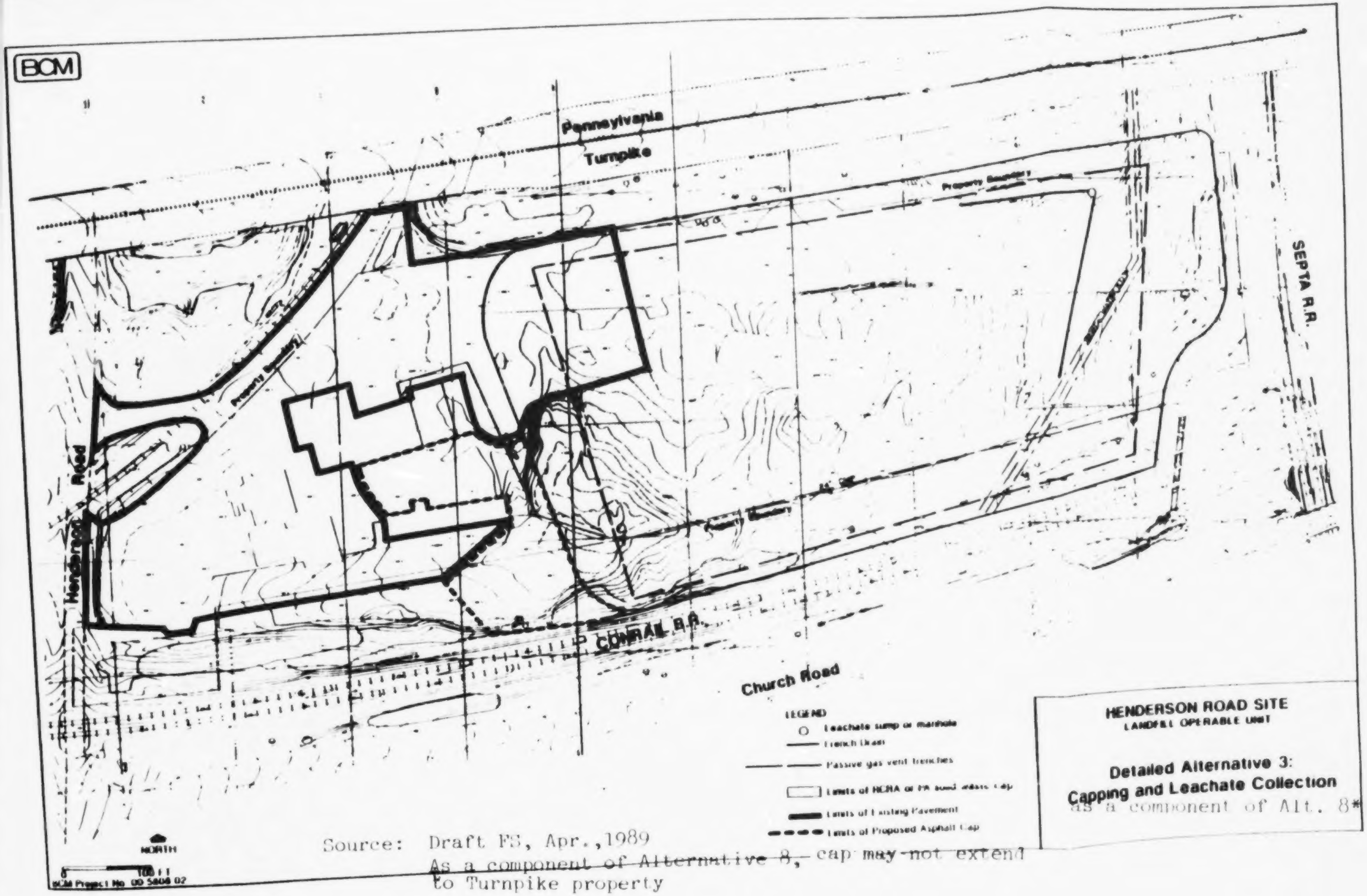
Pollutant	Cleanup Level (ug/l)	Mean Risk to Exposed Individual	Hazard Index (Intake/RfD)
Arsenic and Compounds	50.00	2.50E-03	
Barium and Compounds	5000.00		2.86
Cadmium and Compounds	10.00		0.99
Chromium	50.00		0.29
Copper and Compounds	1300.00		1.00
Lead and Compounds	20.00		4.08
Silver and Compounds	50.00		0.48
Zinc and Compounds	5000.00		0.68
Cyanides	200.00		0.29
Benzoic acid	700.00		0.01
2,4-Dimethylphenol	400.00		1.90
Phenol	3500.00		2.50
2-Methylphenol (o-cresol)	42.00		0.01
p-Cresol (4-Methylphenol)	72.00		0.04
Bis(2-ethylhexyl)phthalate	512.00	2.05E-04	0.73
Butyl benzyl phthalate	820.00		
1,2-Dichlorobenzene	620.00		0.20
1,3-Dichlorobenzene	470.00		0.15
Dibutyl Phthalate	770.00		0.22
Naphthalene	350.00		0.03
n-Nitrosodiphenylamine	71.00	9.94E-06	
Benzyl alcohol	364.00		0.23
4-Chloroaniline	35.00		0.25
2-Methylnaphthalene	1750.00		0.10
Benzene	5.52	4.57E-06	
Carbon Tetrachloride	5.00	1.86E-05	0.20
Chlorobenzene	60.00		0.06
Chloroethane	19,000.00		N/A
Chloroform	100.00	1.74E-05	0.29
Chlorodibromomethane	100.00		0.14
Bromodichloromethane	100.00		0.14
1,1-Dichloroethane	5.06	1.32E-05	0.00
1,2-Dichloroethane (EDC)	6.02	1.57E-05	
1,1-Dichloroethylene	7.00	1.[illegible]0E-04	0.02
1,2-Dichloroethylene-c	70.00		0.20
1,2-Dichloroethylene-t	70.00		0.10
1,2-Dichloropropane	6.28	1.13E-06	
Ethylbenzene	680.00		0.19
Dichloromethane	47.00	1.01E-05	0.02
Tetrachloroethylene	6.90	1.01E-05	0.02
Toluene	2000.00		0.19
Trichloroethylene	25.80	8.11E-06	
Trichlorofluoromethane	12000.00		0.38
Vinyl Chloride	2.00	1.31E-04	
Xylene (mixed)	175.00		0.00
1,3-Dichloropropene	5.00	2.57E-05	0.48

Source: Roy Smith, EPA Toxicologist, September, 1989

Pollutant	Cleanup Level (ug/l)	Mean Risk to Exposed Individual	Hazard Index (Intake/RfD)
Bis(2-chloroethyl)ether	5.70	1.79E-04	
Benzidine	16.50	1.08E-01	0.20
Hexachlorobenzene	1.90	9.17E-05	0.07
Hexachlorobutadiene	0.90	2.01E-06	0.01
Aldrin	0.00	1.94E-06	0.00
Benzo(a)pyrene equivalents	2.50	8.21E-04	
DDT	0.01	1.17E-07	0.00
	Total:	1.13E-01	19.76

4.19E-03
Without benzidine

EXHIBIT 19


BCM
Pennsylvania Turnpike
Property Boundary
Henderson Road
SEPTA R.R.
CONRAIL R.R.
Church Road
LEGEND
○ Leachate sump or manhole
French Drain
Passive gas vent trenches
Limits of RCRA or PA solid waste cap
Limits of Existing Pavement
Limits of Proposed Asphalt Cap
NORTH
0 100 f t
BCM Project No. 00 5808 02

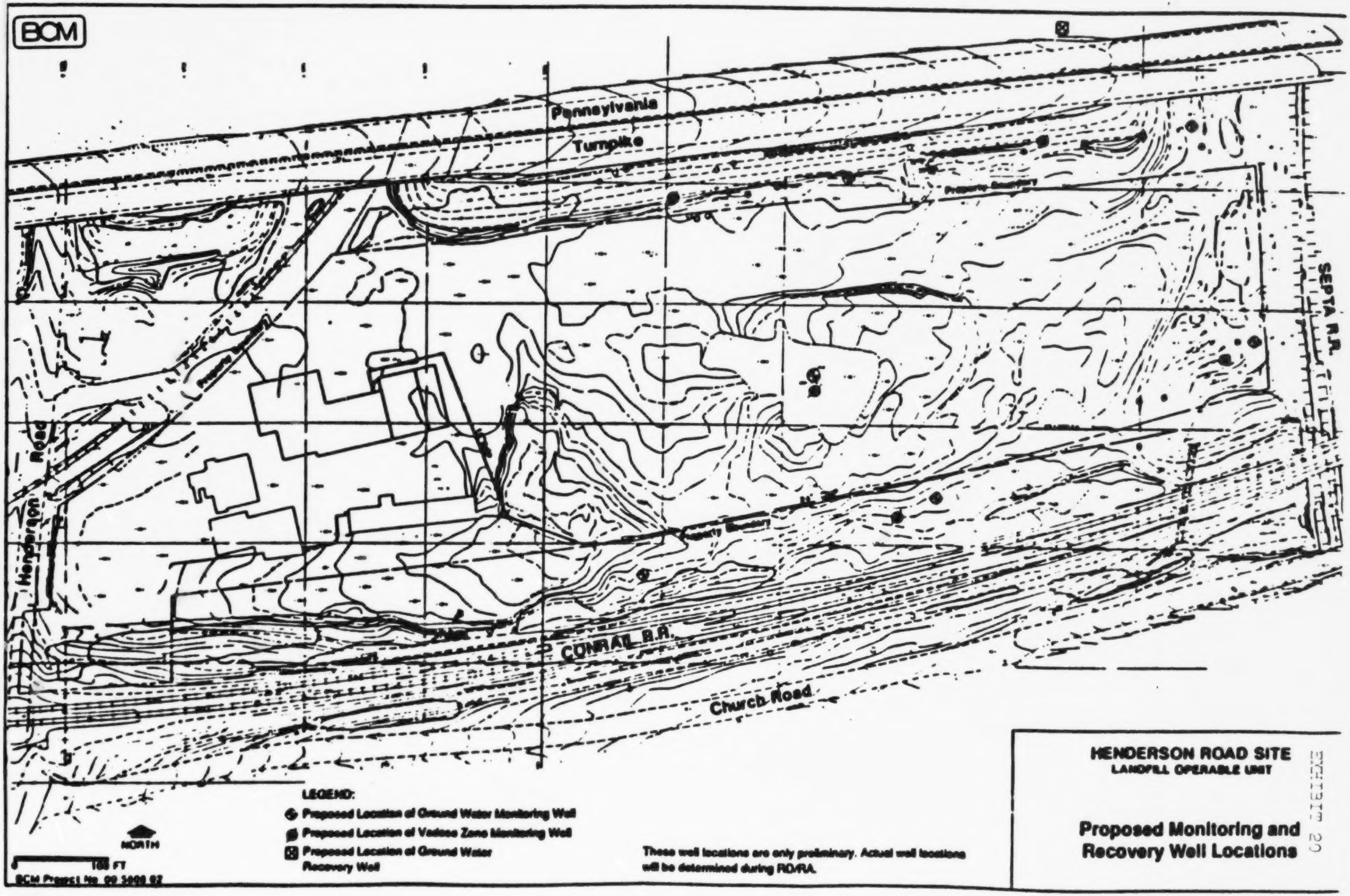
HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

Detailed Alternative 3:
Capping and Leachate Collection
as a component of Alt. 8*

Source: Draft FS, Apr., 1989
As a component of Alternative 8, cap may not extend
to Turnpike property

[redacted]

EXHIBIT 20


BCM
Pennsylvania Turnpike
Property Boundary
SEPTA R.R.
CONRAIL R.R.
Church Road
Henderson Road
NORTH
0 100 FT
BCM Project No. 00 5000 02

LEGEND:

- ⊕ Proposed Location of Ground Water Monitoring Well
- ● Proposed Location of Vadose Zone Monitoring Well
- ⊡ Proposed Location of Ground Water Recovery Well

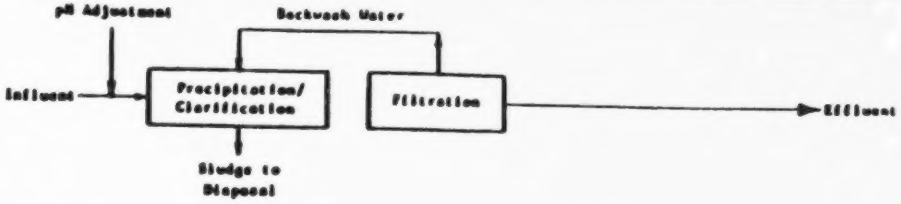
These well locations are only preliminary. Actual well locations will be determined during RD/RA.

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

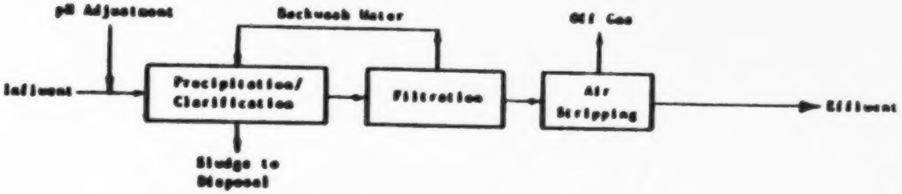
Proposed Monitoring and Recovery Well Locations

EXHIBIT 21

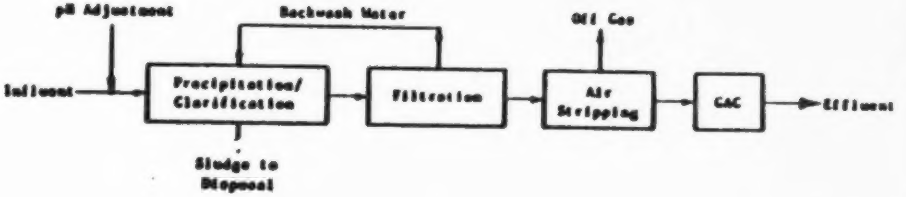
1. If heavy metals removal is the only concern based on the initial sampling results then the following should be piloted.


pH Adjustment
Backwash Water
Influent
Precipitation/
Clarification
Filtration
Effluent
Sludge to
Disposal

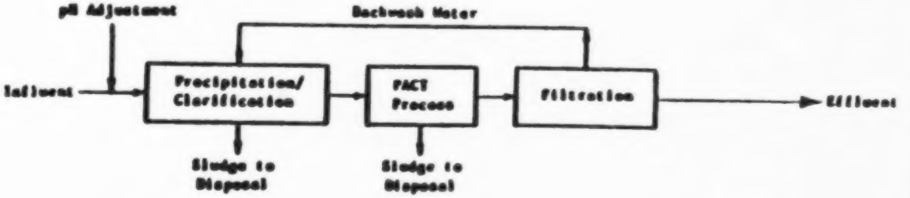
2. If heavy metals and VOCs are the concern then the following should be piloted.


pH Adjustment
Backwash Water
Off Gas
Influent
Precipitation/
Clarification
Filtration
Air
Stripping
Effluent
Sludge to
Disposal

3. If heavy metals, VOCs and refractory organics are the concern then the following should be piloted.


pH Adjustment
Backwash Water
Off Gas
Influent
Precipitation/
Clarification
Filtration
Air
Stripping
GAC
Effluent
Sludge to
Disposal

4. If heavy metals, VOCs and biodegradable organics are the concern then the following should be piloted.


pH Adjustment
Backwash Water
Influent
Precipitation/
Clarification
PACT
Process
Filtration
Effluent
Sludge to
Disposal
Sludge to
Disposal

Note: DER's preferred alternative is essentially #2 (without filtration). The other three treatment trains are developed from technologies which have passed DER's screening but were not preferred.

CDM

environmental engineers, scientists,
planners & management consultants

Pilot Study Process Schematics

FOR TREATING GROUND WATER: TWOU AND LOU
Henderson Road Injection Well Site
Montgomery County, Pennsylvania

SITE SPECIFIC GUIDANCE DOCUMENTS

1) Report: Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final, prepared by U.S. EPA, 10/88.

GENERAL GUIDANCE DOCUMENTS *

1) "Promulgation of Sites from Updates 1-4," Federal Register, dated 6/10/86.

2) "Proposal of update 4," Federal Register, dated 9/18/85.

3) Memorandum to U. S. EPA from Mr. Gene Lucero regarding community relations at Superfund Enforcement sites, dated 8/28/85.

4) Groundwater Contamination and Protection, updated by Mr. Donald V. Feliciano on 8/28/85.

5) Guidance on Remedial Investigations under CERCLA, dated 6/85.

6) Guidance on Feasibility Studies under CERCLA, dated 6/85.

7) "Proposal of Update 3," Federal Register, dated 4/10/85.

8) Memorandum to U. S. EPA from Mr. Jack McGraw entitled "Community Relations Activities at Superfund Sites - Interim Guidance," dated 3/22/85.

9) "Proposal of Update 2," Federal Register, dated 10/15/84.

10) EPA Groundwater Protection Strategy, dated 9/84.

11) Memorandum to U. S. EPA from Mr. William N. Heckman, Jr. entitled "Transmittal at Superfund Removal Procedures - Revision 2," dated 8/20/84.

12) "Proposal of Update 1," Federal Register, dated 9/8/83.

13) Community Relations in Superfund: A Handbook (interim version), dated 9/83.

14) "Proposal of first National Priority List," Federal Register, dated 12/30/82.

15) "Expanded Eligibility List," Federal Register, dated 7/23/82.

16) "Interim Priorities List," Federal Register, dated 10/23/81.

17) Uncontrolled Hazardous Waste Site Ranking System: A User's Manual (undated).

18) Field Standard Operating Procedures- Air Surveillance (undated).

19) Field Standard Operating Procedures- Site Safety Plan (undated).

*Located in U. S. EPA Region III office.

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COMPENDIUM OF CERCLA RESPONSE SELECTION GUIDANCE DOCUMENTS

Doc No.	Vol	Title	Date	Authors	Status	Pages	Tier	Attachments	OSWER/EPA Number
0000	1	INDEX TO COMPENDIUM OF CERCLA RESPONSE SELECTION GUIDANCE DOCUMENTS	05/01/89	- OWPE - PRC ENVIRONMENTAL MANAGEMENT, INC	Final	8		1) DATA ELEMENT DEFINITIONS 2) ORGANIZATIONAL ABBREVIATIONS AND ACRONYMS IDENTIFIED IN INDEX	
**		Pre Remedial							
0001	1	EXPANDED SITE INSPECTION TRANSITIONAL GUIDANCE FOR FY 88	10/01/87	- OERR	Final	74	2		OSWER #9345 1 02
0002	1	PRELIMINARY ASSESSMENT GUIDANCE FISCAL YEAR 1988	01/01/88	- OERR/HSCD	Final	83	2		OSWER #9345 0 01
**		Removal Action							
1000	1	CERCLA REMOVAL ACTIONS AT METHANE RELEASE SITES	01/23/86	- LONGEST, H.L. /OERR	Final	2	2		OSWER #9360 0 8
1001	1	COSTS OF REMEDIAL RESPONSE ACTIONS AT UNCONTROLLED HAZARDOUS WASTE SITES	01/01/81	- RISHEL, H.L., ET AL /SCS ENGINEERS - ALBRECHT, O.W. /MERL	Final	164	1		
1002	1	EMERGENCY RESPONSE PROCEDURES FOR CONTROL OF HAZARDOUS SUBSTANCE RELEASES	01/01/83	- MELVOLD, R.W. /ROCKWELL INTERNATIONAL - MCCARTHY, L.T. /MERL	Final	23	1		EPA 600/2 84 023
1003	1	ENVIRONMENTAL REVIEW REQUIREMENTS FOR REMOVAL ACTIONS	04/13/87	- OERR/ERD	Final	6	2		OSWER #9318 0 05
1004	1	GUIDANCE ON IMPLEMENTATION OF THE "CONTRIBUTE TO REMEDIAL PERFORMANCE" PROVISION	04/06/87	- OSWER	Final	6	2		OSWER #9360 0 13
1008	2	GUIDANCE ON NON-NPL REMOVAL ACTIONS INVOLVING NATIONALLY SIGNIFICANT OR PRECEDENT SETTING ISSUES	04/03/89	- LONGEST, H.L. /OERR	Final	9	2	1) REQUEST FOR CONCURRENCE	OSWER #9360 0 19
1005	1	INFORMATION ON DRINKING WATER ACTION LEVELS	04/19/88	- FIELDS, JR., T. /OSWER/ERD	Final	17	2	1) MEMO: RELEASES FROM LAWFULLY APPLIED PESTICIDES 2) MEMO: EDB CONTAMINATION 3) GUIDANCE FOR ETHYLENE DIBROMIDE IN DRINKING H2O	
1006	1	SUPERFUND REMOVAL PROCEDURES: REVISION #3	02/01/88	- OSWER/OERR	Final	365	1		OSWER #9360 0 03B
1007	1	THE ROLE OF EXPEDITED RESPONSE ACTIONS UNDER SARA	04/21/87	- LONGEST, H.L. /OERR	Final	3	2		OSWER #9360 0 15
4002	26	INTERIM FINAL GUIDANCE ON REMOVAL ACTION LEVELS AT CONTAMINATED DRINKING WATER SITES [Secondary Reference]	10/06/87	OSWER/OERR	Final	9	2		OSWER #9360 1 01
6001	32	REMOVAL COST MANAGEMENT MANUAL [Secondary Reference]	04/01/88	OSWER/OERR	Final	170	1		OSWER #9360 0 02B

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COMPENDIUM OF CERCLA RESPONSE SELECTION GUIDANCE DOCUMENTS

Doc No	Vol	Title	Date	Authors	Status	Pages	Tier	Attachments	OSWER/EPA Number
2102	6	DATA QUALITY OBJECTIVES FOR REMEDIAL RESPONSE ACTIVITIES: EXAMPLE SCENARIO: RI/FS ACTIVITIES AT A SITE W/ CONTAMINATED SOILS AND GROUNDWATER	03/01/87	- CDM FEDERAL PROGRAMS CORP - OERR/OWPE	Final	120	1		OSWER #9355.0-7B
2103	6	DESIGN AND DEVELOPMENT OF HAZARDOUS WASTE REACTIVITY TESTING PROTOCOL	02/01/84	- WOLBACH, C.D., ET AL /ACUREX CORP - BARKLEY, N /MERL	Final	150	1		EPA 600/2-84-057
2104	6	FIELD SCREENING FOR ORGANIC CONTAMINANTS IN SAMPLES FROM HAZARDOUS WASTE SITES	04/02/86	- ROFFMAN, H.K., ET AL /NUS CORP - CARTER, A /MICHIGAN DEPT OF NATURAL RESOURCES - THOMAS, T /EPA	Final	11	2	1) MEMO: FIELD SCREENING FOR ORGANIC CONTAMINANTS	
2105	6	FIELD SCREENING METHODS CATALOG: USER'S GUIDE	09/01/88	- OERR/HSCD	Final	90	1		EPA/540/2-88/005
2106	6	FIELD STANDARD OPERATING PROCEDURES MANUAL #4 SITE ENTRY	01/01/85	- OERR/ERD	Final	29	2		OSWER #9285.2-01
2107	7	FIELD STANDARD OPERATING PROCEDURES MANUAL #6 WORK ZONES	04/01/85	- OERR/ERD	Final	19	2		OSWER #9285.2-04
2108	7	FIELD STANDARD OPERATING PROCEDURES MANUAL #8 AIR SURVEILLANCE	01/01/85	- OERR/ERD	Final	24	2		OSWER #9285.2-03
2109	7	FIELD STANDARD OPERATING PROCEDURES MANUAL #9 SITE SAFETY PLAN	04/01/85	- OERR/ERD	Final	26	2	1) SAMPLE SITE SAFETY PLAN AND OSHA SAFETY PLAN 2) EMERGENCY OPERATION CODES REAL TIME MONITOR 3) RESPONSE SAFETY CHECK-OFF SHEET	OSWER #9285.2-05
2110	7	GEOPHYSICAL METHODS FOR LOCATING ABANDONED WELLS	07/01/84	- FRISCHKNECHT, F.C., ET AL /U.S. GEOLOGICAL SURVEY - VANEE, J.J. /EMSL	Final	211	1		EPA 600/4-84-065
2111	7	GEOPHYSICAL TECHNIQUES FOR SENSING BURIED WASTES AND WASTE MIGRATION	06/01/84	- BENSON, R.C., ET AL /TECHNOS, INC. - VANEE, J.J. /EMSL	Final	236	1		EPA 600/7-84/064
2112	8	GUIDELINES AND SPECIFICATIONS FOR PREPARING QUALITY ASSURANCE PROGRAM DOCUMENTATION	06/01/87	- ORD/QUALITY ASSURANCE MANAGEMENT STAFF	Final	31	2	1) MEMO: GUIDANCE ON PREPARING QAPPS DATED 6/10/87	
2113	8	LABORATORY DATA VALIDATION FUNCTIONAL GUIDELINES FOR EVALUATING INORGANICS ANALYSES	07/01/88	- EPA DATA REVIEW WORK GROUP - BLEYLER, R /VIAR AND CO /SAMPLE MGMT OFFICE - HSED	Draft	20	2		
2114	8	LABORATORY DATA VALIDATION FUNCTIONAL GUIDELINES FOR EVALUATING ORGANICS ANALYSES	02/01/88	- BLEYLER, R /VIAR AND CO /SAMPLE MGMT OFFICE - EPA DATA REVIEW WORKGROUP - HSED	Draft	45	2		

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs) FOR THE HENDERSON ROAD LOU

ARAR	Specific Type	Legal Citation	Proposed Legal Classification	Explanation of Classification	Applicability to FS Options
Federal					
1. Safe Drinking Water Act					
a. Maximum Contaminant Levels (MCLs)	Contaminant	40 CFR Part 141	Applicable	Enforceable STDs for public drinking water supply systems	If contingency groundwater treatment is triggered through monitoring, SDWA requirements may be applicable (MCLs) or "to be considered" (secondary MCLs) and (MCLGs) to groundwater at the property line.
b. Maximum Contaminant Level Goals (MCLGs)		SARA Section 121 (d)(2)(A)(ii)	Relevant and Appropriate	Non-enforceable guidelines that do not consider the technical feasibility of contaminant removal	See Above
c. Secondary Maximum Contaminant Levels		40 CFR Part 143	To be considered	Non-enforceable guidelines for public drinking water systems	See Above
d. EPA's Groundwater Protection Strategy	Action	None	To be considered	Unenforceable policy regarding protection of groundwater resources	To be considered if groundwater treatment is triggered through monitoring.
2. Clean Water Act		PL92-500			
a. Ambient Water Quality Criteria (AWQC)	Contaminant	Section 304(a)(1)	To be considered	Non-enforceable, used to develop standards	If contingency groundwater treatment is triggered through montoring, CWA requirements may be a "to be considered" (AWQC). May also be applicable for surface water discharges if receiving water is considered navigable (NPDES).

EXHIBIT 17

ARAR	Specific Type	Legal Citation	Proposed Legal Classification	Explanation of Classification	Applicability to FS Options
Federal (Continued)					
b. General Pre-treatment Regulations	Contaminant	40CFR Part 403	Relevant and Appropriate	Enforceable standards for discharge to a POTW	If continency groundwater treatment is required, these regulations may be relevant and appropriate to a recovered groundwater discharged. Also relevant and appropriate if leachate is pretreated and/or discharged to a POTW.
3. EPA Health Advisories	Contaminant	EPA Office of Drinking Water	To be considered	Non-enforceable guidelines for public water supply systems	To be considered if contingency grrundwater treatment is triggered through monitoring. Health advisories may be applicable for contaminants not regulated under SDWA.
4. Health Effects Assessments (HEAs)	Contaminant	None	To be considered	Non-enforceable toxicity data for specific chemicals for use in public health assessments. Also to be considered are carcinogenic potency factors and reference doses provided in the Superfund Public Health Evaluation Manual (EPA, 1986)	To be considered where remedial alternatives address risk-based criteria or standard setting for cleanup. Also applies to dust emissions, emissions during excavation and emission from leachate or groundwater treatment units.

EXHIBIT 11

SUMMARY OF CANCER RISK FACTORS AND HAZARD INDICES

INJECTION WELL OPERABLE UNIT
HENDERSON ROAD SITE
UPPER MERION, PENNSYLVANIA

Model	Description	CRF	HI
Scenario I:	Based on a hypothetical sample using aggregate maximum concentrations (including HR-2-195) from Site wells (i.e., data do not represent an actual sample)		
Model 1:	Direct ingestion of hypothetical sample	36,284	385.6
Model 2:	Simulated incorporation into the UMR of hypothetical sample	1,091	11.6
Model 3:	Simulated incorporation into the UMR of the hypothetical sample for all chemicals of concern added to aggregate maximum concentrations found in the UMR	1,277	13.7
Model 4:	Simulated incorporation into the UMR of Site chemicals not found in the UMR and maximum concentrations found in the UMR	188.6	2.9
Scenario II:	Based on a hypothetical sample using average concentrations from Site wells (without HR-2-195 or HR-5-192)		
Model 5:	Simulated incorporation into the UMR for all chemicals of concern	257.5	3.1
Scenario III:	Based on concentrations of chemicals found in untreated UMR water. Aggregate maximum values compiled from all data		
Model 6:	Maximum concentrations in untreated UMR water for chemicals of concern	187.4	2.2
Model 7:	Average concentrations in untreated UMR water for chemicals of concern	75.8	0.6

(EXHIBIT 11 CONT'D)

Model	Description	CRF	HI
Model 8:	Maximum concentrations in untreated UMR water for all chemicals found in the UMR	228.0	2.3
Model 9:	Average concentrations in untreated UMR water for all chemicals found in the UMR	86.6	0.6
Scenario IV:	Based on concentrations of chemicals found in treated UMR water. Aggregate maximum values used.		
Model 10:	Maximum concentrations in treated UMR water for chemicals of concern	19.2	1.5
Model 11:	Average concentrations in treated UMR water for chemicals of concern	6.2	0.7
Model 12:	Maximum concentrations in treated UMR water for all chemicals found in the UMR	44.0	1.5
Model 13:	Average concentrations in treated UMR water for all chemicals found in the UMR	18.7	0.7
McIlvain Well Water		6.8	0.009

CFR - Probability of cancer incidence in a population of 1,000,000 people
HI - Hazard index

Source: BCM Eastern Inc. (BCM Project No. 00-5528-02)

EXHIBIT 12

CARCINOGENIC RISK ASSESSMENT
INJECTION WELL OPERABLE UNIT
HENDERSON ROAD SITE
UPPER MERION, PENNSYLVANIA

Chemical	Exposure Models based on Concentrations at Site									
	Model 1		Model 2		Model 3		Model 4		Model 5	
	CRF	Percent	CRF	Percent	CRF	Percent	CRF	Percent	CRF	Percent
Carcinogens Found Only at Site										
Bis(2-Ethylhexyl) Phthalate	6.64	0.0	0.20	0.0	0.20	0.0	0.20	0.1	0.01	0.0
4-Chloroaniline	31.49	0.1	0.92	0.1	0.92	0.1	0.92	0.5	0.38	0.1
N-Nitrosodiphenylamine	5.60	0.0	0.17	0.0	0.17	0.0	0.17	0.1	0.07	0.0
Carcinogens Found at Site and UMR										
Benzene	2,525.71	7.0	75.77	6.9	76.51	6.0	0.74	0.4	27.34	10.7
Chloroform	1,002.09	2.8	31.98	2.9	82.85	6.5	52.77	28.0	7.64	3.0
1,1-Dichloroethane	7,748.00	21.4	232.44	21.3	235.04	18.4	2.60	1.4	62.66	24.4
1,2-Dichloroethane	1,066.00	2.9	31.90	2.9	32.50	2.5	0.52	0.3	7.80	3.0
1,1-Dichloroethene	1,690.29	4.7	51.37	4.7	59.66	4.7	8.29	4.4	24.86	9.7
Methylene Chloride	182.14	0.5	5.46	0.5	6.17	0.5	0.71	0.4	1.05	0.4
Tetrachloroethene	14,280.00	39.4	428.40	39.3	433.79	34.0	5.39	2.9	3.64	1.4
Trichloroethene	191.71	0.5	5.75	0.5	9.81	0.8	4.05	2.1	1.26	0.5
Vinyl Chloride	6,571.43	18.1	197.14	18.1	262.86	20.6	65.71	34.8	111.71	43.5
Carbon Tetrachloride#	371.43	1.0	11.14	1.0	14.86	1.2	3.71	2.0	3.09	1.2
Dichlorobromomethane#	371.43	1.0	11.14	1.0	47.54	3.7	36.40	19.3	3.09	1.2
Dibromochloromethane#	240.00	0.7	7.2	0.7	13.68	1.1	6.48	3.4	1.99	0.8
Total Cancer Risk Factor (Per 1,000,000 People)	36,283.96		1,090.98		1,276.55		188.66		256.59	

EXHIBIT 12

(EXHIBIT 12 CONT'D)

Exposure Models based on Data for Upper Merion Reservoir

Chemical	Untreated UMR Water								Treated UMR Water							
	Model 6		Model 7		Model 8		Model 9		Model 10		Model 11		Model 12		Model 13	
	CRF	Percent	CRF	Percent	CRF	Percent	CRF	Percent	CRF	Percent	CRF	Percent	CRF	Percent	CRF	Percent
Carcinogens Found at Site and UMR																
Benzene	0.74	0.4	0.74	1.0	0.74	0.3	0.74	0.9	0.74	3.9	0.74	12.0	0.74	1.7	0.74	4.0
Chloroform	52.77	28.1	1.39	1.8	52.77	23.1	1.39	1.6	2.55	13.3	0.69	11.2	2.55	5.8	0.69	3.7
1,1-Dichloroethane	2.60	1.4	1.30	1.7	2.60	1.1	1.30	1.5	1.56	8.1	0.52	8.4	1.56	3.5	0.52	2.8
1,2-Dichloroethane	0.52	0.3	0.26	0.3	0.52	0.2	0.26	0.3	2.08	10.8	0.26	4.2	2.08	4.7	0.26	1.4
1,1-Dichloroethene	8.29	4.4	1.66	2.2	8.29	3.6	1.66	1.9	4.97	25.9	1.66	26.8	4.97	11.3	1.66	8.8
Methylene Chloride	0.71	0.4	0.02	0.0	0.71	0.3	0.02	0.0	0.09	0.5	0.02	0.3	0.09	0.2	0.02	0.1
Tetrachloroethene	5.39	2.9	1.17	1.5	5.39	2.4	1.17	1.3	0.44	2.3	0.15	2.4	0.44	1.0	0.15	0.8
Trichloroethene	4.05	2.2	2.11	2.8	4.05	1.8	2.11	2.4	1.95	10.1	0.50	8.1	1.95	4.4	0.50	2.7
Vinyl Chloride	65.71	35.1	65.71	86.7	65.71	28.8	65.71	75.9	0.65	3.4	0.65	10.5	0.65	1.5	0.65	3.5
Carbon Tetrachloride#	3.71	2.0	0.37	0.5	3.71	1.6	0.37	0.2	2.97	15.5	0.37	0.2	2.97	6.8	0.37	2.0
Dichlorobromomethane#	36.40	19.4	0.74	1.0	36.40	16.0	0.74	0.4	0.74	3.9	0.37	0.2	0.37	0.8	0.37	2.0
Dibromochloromethane#	6.48	3.5	0.24	0.3	6.48	2.8	0.24	0.1	0.48	2.5	0.24	0.1	0.48	1.1	0.24	1.3
Carcinogens Found Only at UMR																
1,1,2,2-Tetrachlorethane	0.00	0.0	0.00	0.0	6.29	2.8	0.57	0.7	0.00	0.0	0.00	0	0.57	1.3	0.57	3.0
1,2,3-Trichloropropane	0.00	0.0	0.00	0.0	34.29	15.0	10.29	11.9	0.00	0.0	0.00	0	24.57	55.9	12.00	64.0
Total Cancer Risk Factor (Per 1,000,000 People)	187.47		75.80		227.95		86.57		19.22		6.17		43.99		18.74	

Chemicals not found in site-related samples. Risk calculations based on detection limits.

Source: BCM Eastern Inc. (Project No. 00-5528-02)

EXHIBIT 12

EXHIBIT 12

HAZARD INDEX (HI) FOR CHEMICALS WITH NON-CARCINOGENIC EFFECTS
INJECTION WELL OPERABLE UNIT
HENDERSON ROAD SITE
UPPER MERION, PENNSYLVANIA

Chemical	Model 1		Model 2		Model 3	
	HI	Percent	HI	Percent	HI	Percent
Chemicals with Non-carcinogenic Effects Found Only at Site						
Benzoic Acid	0.5857	0.2	0.0176	0.2	0.0176	0.1
Benzyl Alcohol	1.4857	0.4	0.0429	0.4	0.0429	0.3
Bis(2-Ethylhexyl)Phthalate	0.4857	0.1	0.0146	0.1	0.0146	0.1
Butyl Benzyl Phthalate	3.3416	0.9	0.1002	0.9	0.1002	0.7
4-Chloroaniline	1.6571	0.4	0.0486	0.4	0.0486	0.4
2,4-Dimethylphenol	0.1117	0.0	0.0034	0.0	0.0034	0.0
Di-n-butyl Phthalate	0.0519	0.0	0.0016	0.0	0.0016	0.0
2-Methylnaphthalene	0.0229	0.0	0.0007	0.0	0.0003	0.0
2-Methylphenol	11.6600	3.0	0.3500	3.0	0.3500	2.6
4-Methylphenol	4.7143	1.2	0.1414	1.2	0.1414	1.0
Naphthalene	0.0014	0.0	0.0000	0.0	0.0000	0.0
Phenol	0.0200	0.0	0.0006	0.0	0.0006	0.0
m-Xylene	1.0286	0.3	0.0309	0.3	0.0309	0.2
p-Xylene	0.2714	0.1	0.0081	0.1	0.0081	0.1
Chemicals with Non-carcinogenic Effects Found at Site and UMR						
Chlorobenzene	0.3280	0.1	0.0098	0.1	0.0132	0.1
Chloroform	1.2371	0.3	0.0371	0.3	0.1023	0.7
1,4-Dichlorobenzene	1.0700	0.3	0.0314	0.3	0.0320	0.2
1,1-Dichloroethane	0.7095	0.2	0.0213	0.2	0.0215	0.2
1,1-Dichloroethene	0.3238	0.1	0.0098	0.1	0.0114	0.1
Trans-1,2-Dichloroethene	11.2143	2.9	0.3371	2.9	0.3443	2.5
1,2-Dichloropropane	300.7519	78.0	9.0225	78.0	11.0276	80.5
Ethylbenzene	2.2286	0.6	0.0669	0.6	0.0707	0.5
Methylene Chloride	0.4048	0.1	0.0121	0.1	0.0137	0.1
Tetrachloroethene	14.0000	3.6	0.4200	3.6	0.4253	3.1
Toluene	23.4286	6.1	0.7029	6.1	0.7033	5.1
1,1,1-Trichloroethane	0.3987	0.1	0.0120	0.1	0.0137	0.1
Carbon Tetrachloride*	4.0816	1.1	0.1224	1.1	0.1633	1.2
TOTAL HAZARD INDEX**	385.6150		11.5659		13.7023	

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* Concentrations based on detection limits. Not detected in samples from the Site.

** Hazard Index values greater than 1 may indicate adverse health effects.

EXHIBIT 12

(Continued)

Chemical	Model 4 HI	Model 4 Percent	Model 5 HI	Model 5 Percent	Model 6 HI	Model 6 Percent
Chemicals with Non-carcinogenic Effects Found Only at Site						
Benzoic Acid	0.0176	0.6	0.0076	0.2	0.0000	0.0
Benzyl Alcohol	0.0429	1.5	0.0126	0.4	0.0000	0.0
Bis(2-Ethylhexyl)Phthalate	0.0146	0.5	0.0007	0.0	0.0000	0.0
Butyl Benzyl Phthalate	0.1002	3.5	0.0006	0.0	0.0000	0.0
4-Chloroaniline	0.0486	1.7	0.0200	0.6	0.0000	0.0
2,4-Dimethylphenol	0.0034	0.1	0.0013	0.0	0.0000	0.0
Di-n-butyl Phthalate	0.0016	0.1	0.0006	0.0	0.0000	0.0
2-Methylnaphthalene	0.0007	0.0	0.0004	0.0	0.0000	0.0
2-Methylphenol	0.3500	12.1	0.1257	4.0	0.0000	0.0
4-Methylphenol	0.1414	4.9	0.0471	1.5	0.0000	0.0
Naphthalene	0.0000	0.0	0.0000	0.0	0.0000	0.0
Phenol	0.0006	0.0	0.0004	0.0	0.0000	0.0
m-Xylene	0.0309	1.1	0.0088	0.3	0.0000	0.0
p-Xylene	0.0081	0.3	0.0010	0.0	0.0000	0.0
Chemicals with Non-carcinogenic Effects Found at Site and UMR						
Chlorobenzene	0.0034	0.1	0.0034	0.1	0.0034	0.2
Chloroform	0.0651	2.2	0.0146	0.5	0.0651	3.0
1,4-Dichlorobenzene	0.0006	0.0	0.0071	0.2	0.0006	0.0
1,1-Dichloroethane	0.0002	0.0	0.0058	0.2	0.0002	0.0
1,1-Dichloroethene	0.0016	0.1	0.0048	0.2	0.0016	0.1
Trans-1,2-Dichloroethene	0.0071	0.2	0.0771	2.5	0.0714	3.2
1,2-Dichloropropene	2.0050	69.2	2.6734	85.9	2.0050	91.1
Ethylbenzene	0.0038	0.1	0.0131	0.4	0.0038	0.2
Methylene Chloride	0.0016	0.1	0.0023	0.1	0.0016	0.1
Tetrachloroethene	0.0053	0.2	0.0036	0.1	0.0053	0.2
Toluene	0.0004	0.0	0.0442	1.4	0.0004	0.0
1,1,1-Trichloroethane	0.0017	0.1	0.0025	0.1	0.0017	0.1
Carbon Tetrachloride*	0.0408	1.4	0.0327	1.0	0.0408	1.9
TOTAL HAZARD INDEX**	2.8972		3.1114		2.2009	

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* Concentrations based on detection limits. Not detected in samples from the Site.

** Hazard Index values greater than 1 may indicate adverse health effects.

EXHIBIT 12

(Continued)

Chemical	Model 7 HI	Model 7 Percent	Model 10 HI	Model 10 Percent	Model 11 HI	Model 11 Percent	McIlvain HI	McIlvain Percent
Chemicals with Non-carcinogenic Effects Found Only at Site								
Benzoic Acid	0.0000	0.0	0.0000	0.0	0.0000	0.0	0.0000	0.0
Benzyl Alcohol	0.0000	0.0	0.0000	0.0	0.0000	0.0	0.0000	0.0
Bis(2-Ethylhexyl)Phthalate	0.0000	0.0	0.0000	0.0	0.0000	0.0	0.0000	0.0
Butyl Benzyl Phthalate	0.0000	0.0	0.0000	0.0	0.0000	0.0	0.0000	0.0
4-Chloroaniline	0.0000	0.0	0.0000	0.0	0.0000	0.0	0.0000	0.0
2,4-Dimethylphenol	0.0000	0.0	0.0000	0.0	0.0000	0.0	0.0000	0.0
Di-n-butyl Phthalate	0.0000	0.0	0.0000	0.0	0.0000	0.0	0.0000	0.0
2-Methylnaphthalene	0.0000	0.0	0.0000	0.0	0.0000	0.0	0.0000	0.0
2-Methylphenol	0.0000	0.0	0.0000	0.0	0.0000	0.0	0.0000	0.0
4-Methylphenol	0.0000	0.0	0.0000	0.0	0.0000	0.0	0.0000	0.0
Naphthalene	0.0000	0.0	0.0000	0.0	0.0000	0.0	0.0000	0.0
Phenol	0.0000	0.0	0.0000	0.0	0.0000	0.0	0.0000	0.0
m-Xylene	0.0000	0.0	0.0000	0.0	0.0000	0.0	0.0000	0.0
p-Xylene	0.0000	0.0	0.0000	0.0	0.0000	0.0	0.0000	0.0
Chemicals with Non-carcinogenic Effects Found at Site and UMR								
Chlorobenzene	0.0005	0.1	0.0005	0.0	0.0005	0.1	0.0050	55.3
Chloroform	0.0017	0.3	0.0031	0.2	0.0009	0.1	0.0000	0.0
1,4-Dichlorobenzene	0.0006	0.1	0.0004	0.0	0.0004	0.1	0.0000	0.0
1,1-Dichloroethane	0.0001	0.0	0.0001	0.0	0.0000	0.0	0.0031	34.7
1,1-Dichloroethene	0.0003	0.1	0.0010	0.1	0.0003	0.0	0.0000	0.0
Trans-1,2-Dichloroethene	0.0029	0.5	0.0029	0.2	0.0014	0.2	0.0000	0.0
1,2-Dichloropropane	0.6015	98.0	1.4369	97.2	0.7018	98.8	0.0000	0.0
Ethylbenzene	0.0001	0.0	0.0001	0.0	0.0001	0.0	0.0000	0.0
Methylene Chloride	0.0000	0.0	0.0002	0.0	0.0000	0.0	0.0009	10.1
Tetrachloroethene	0.0011	0.2	0.0004	0.0	0.0001	0.0	0.0000	0.0
Toluene	0.0000	0.0	0.0000	0.0	0.0000	0.0	0.0000	0.0
1,1,1-Trichloroethane	0.0008	0.1	0.0003	0.0	0.0002	0.0	0.0000	0.0
Carbon Tetrachloride*	0.0041	0.7	0.0327	2.2	0.0041	0.6	0.0000	0.0
TOTAL HAZARD INDEX**	0.6139		1.4788		0.7100		0.0090	

---

* Concentrations based on detection limits. Not detected in samples from the Site.

** Hazard Index values greater than 1 may indicate adverse health effects.

Source: BCM Eastern Inc. (BCM Project No. 00-5528-02)

EXHIBIT 13

INDICATOR CHEMICALS
CONCENTRATIONS USED IN RISK ASSESSMENT

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

	Soil[a] (ug/kg)		Water (ug/l)	
	Maximum	Mean[b]	Maximum	Mean[b]
VOLATILE ORGANICS				
Benzene	410	11	152	4.4
Chloroform	70	5.8	30.2	1.4
Ethylbenzene	3,920	23.7	52.6	10.7
Tetrachloroethene	4,100	19.8	34.9	1.4
Toluene	4,650	106.7	844.0	214.5
Trichloroethene	2,850	8.3	14.1	1.2
Trichlorofluoromethane	540	24.1	368.0	13.2
1,3-Dichloropropene**	50	5.7	10.3	1.1
SEMIVOLATILE ORGANICS				
Benzidine	7,300	630	NA	NA
Bis(2-chloroethyl)ether	62,000	947	92	10.0
Hexachlorobenzene	69,000	1,002	16	6.3
Hexachlorobutadiene	56,000	1,024	35	32.4
PAHs	955,000	9,129	100.8[d]	84.2[d]
PAHs*	411,220	3,652	82.3[d]	61.5[d]
PCBs***	13,800	3.5	13[d]	0.003[d]
INORGANICS				
Barium	253,000	45,000[c]	267	264
Chromium	198,000	16,000[c]	10	5
Lead	156,000	24,000	27	3
PESTICIDES				
Aldrin	2.5	0.29	16.0	0.9
4,4'-DDT	37	0.84	3.2	3.1

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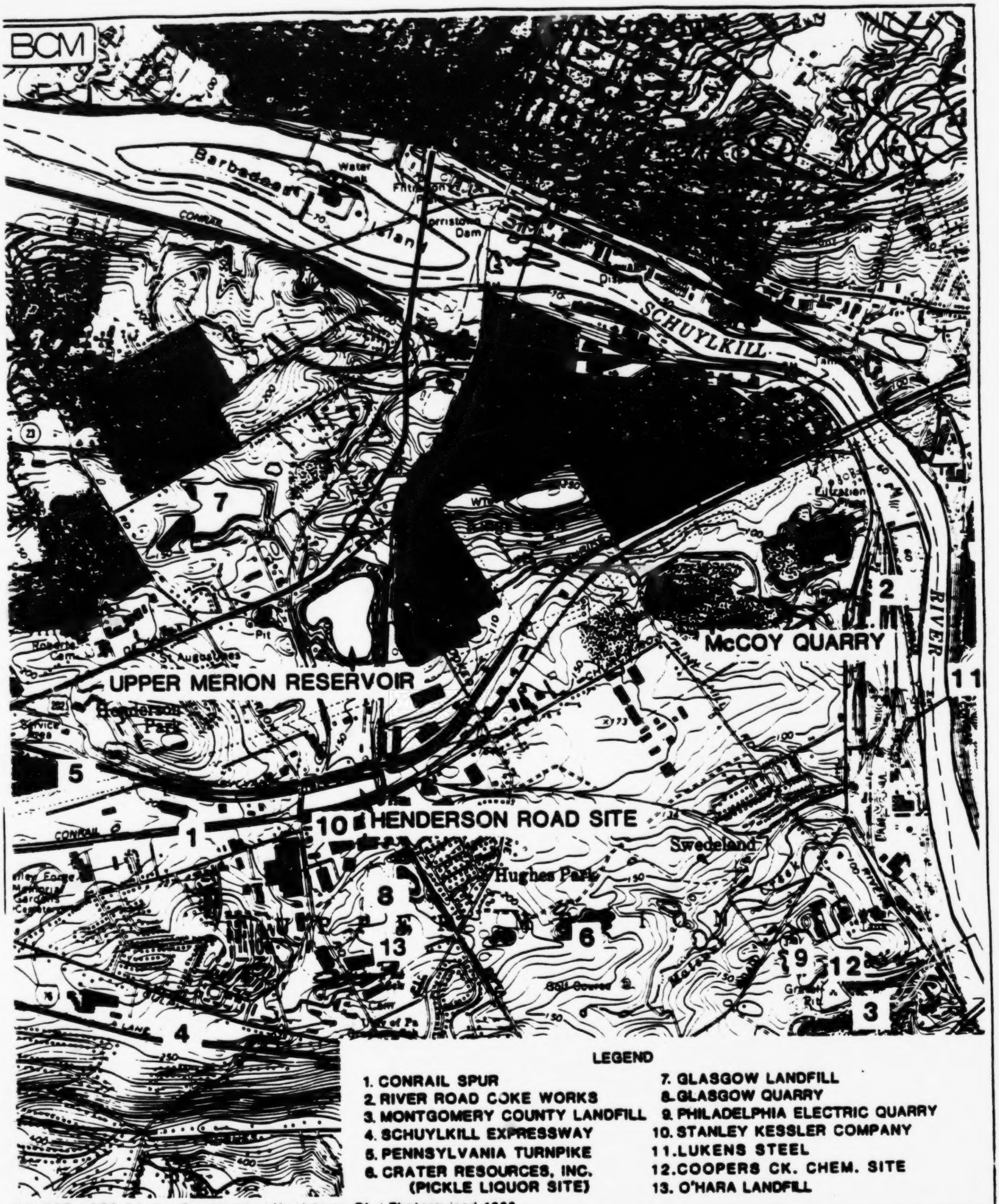
* Adjusted Concentration (Section 5.4)
** Both isomers
*** Total
a Onsite soil, fill and sediment
b Geometric mean
c Below background
d Estimated concentration using certain soil data (see Section 5.2.4)
NA Not applicable

Source: BCM Engineers (Project No. 00-5808-02)

EXHIBIT 14


BCM
Barbadoes Island
Water
Filtration Plant
Norristown Dam
CONRAIL
SCHUYLKILL
RIVER
UPPER MERION RESERVOIR
McCOY QUARRY
HENDERSON ROAD SITE
Henderson Park
Swedeland
Hughes Park
Pit
St Augustines
CONRAIL
1
2
3
4
5
6
7
8
9
10
11
12
13

LEGEND

1. CONRAIL SPUR
2. RIVER ROAD COKE WORKS
3. MONTGOMERY COUNTY LANDFILL
4. SCHUYLKILL EXPRESSWAY
5. PENNSYLVANIA TURNPIKE
6. CRATER RESOURCES, INC. (PICKLE LIQUOR SITE)
7. GLASGOW LANDFILL
8. GLASGOW QUARRY
9. PHILADELPHIA ELECTRIC QUARRY
10. STANLEY KESSLER COMPANY
11. LUKENS STEEL
12. COOPERS CK. CHEM. SITE
13. O'HARA LANDFILL

SOURCE: USGS 7.5 min. Quadrangle / Norristown, PA / Photorevised 1983

north
0 2000ft.
0-5528-01 and 00-5528-02

HENDERSON ROAD
REMEDIAL INVESTIGATION
King of Prussia, PA

Potential Groundwater Contamination Sources

EXHIBIT 15

PROPOSED CHEMICAL SPECIFIC ARARS FOR
HENDERSON ROAD SITE
INJECTION WELL AND LANDFILL OPERABLE UNITS*

Parameter (µg/l)	IWOU	LOU	ARAR (µg/l)	Method/ Source
METALS				
Arsenic	x		50.0 (30)	MCL (PMCL)
Barium		x	5,000.0	PMCL
Cadmium	x		10.0 (5)	MCL (PMCL)
Chromium (total)	x	x	50.0 (100)	MCL (PMCL)
Copper	x		1,300.0 (1000)	MCLG (PMCL)
Lead	x	(x)	20.0 (5.0)	MCLG (PMCL)
Silver	x		50.0	MCLG
Zinc	x		5,000.0	Mc
OTHER PARAMETERS				
Cyanide	x		200.0	AWQC
ACID EXTRACTABLE ORGANICS				
Benzoic acid	x		700.0	Ma
2,4-Dimethylphenol	x		400.0	AWQC
Phenol	x		3,500.0	DWEL
2-Methylphenol	x		42.0	Ma
4-Methylphenol	x		72.0	Ma
BASE/NEUTRAL EXTRACTABLE ORGANICS				
Benzidine		x	16.5	CLP
Bis (2-ethylhexyl) phthalate	x		512.0	
Bis(2-chloroethyl)ether		x	5.7	CLP
Butyl Benzyl Phthalate	x		820.0	Ma
1,2-Dichlorobenzene	x		620.0 (600)	MCLG (PMCL)
1,3-Dichlorobenzene	x		470.0	AWQC
1,4-Dichlorobenzene	x		75.0	MCL
Di-n-butyl phthalate	x		770.0	SNARL
Hexachlorobenzene		x	1.9	CLP
Hexachlorobutadiene		x	0.9	CLP
Naphthalene	x		350.0	Ma
PAH (benzo(a)pyrene)		x	2.5	CLP
N-nitrosodiphenyamine	x		71.0	***
Benzyl alcohol	x		364.0	Ma
4-Chloroaniline	x		35.0	Ma
2-Methylnaphthalene	x		1,750.0	Ma

EXHIBIT 15
(Continued)

PROPOSED CHEMICAL SPECIFIC ARARS FOR HENDERSON ROAD SITE INJECTION WELL AND LANDFILL OPERABLE UNITS*

Parameter (µg/l)	IWOU	LOU	ARAR (µg/l)	Method/ Source
VOLATILE ORGANICS				
Benzene	x	(x)	5.52 (5.0)	b (MCL)
Carbon Tetrachloride	x		5.0	MCL
Chlorobenzene	x		60.0	MCLG
Chloroethane	x		19,000.0	EPA
Chloroform	x	x	100.0	MCL[a]
Dibromochloromethane	x		100.0	MCL[a]
Dichlorobromomethane	x		100.0	MCL
Dichlorobromethane	x		100.0	MCL
1,1-Dichloroethane	x		5.06	b
1,2-Dichloroethane	x		6.02	b
1,1-Dichloroethene	x		7.0	MCL
1,2-Dichloroethene	x		70.0	MCLG/PMCL
1,2-Dichloropropane	x		6.28	b
1,3-Dichloropropene		x	5.0	CLP
Ethylbenzene	x	x	680.0	MCLG/PMCL
Methylene Chloride	x		47.0	***
Tetrachlorethene (PCE)	x	(x)	6.9 (5.0)	*** (PMCL)
Toluene	x	x	2,000.0	MCLG/PMCL
Trichloroethene (TCE)	x	(x)	25.8 (5.0)	b (MCL)
Trichlorofluoromethane	x	x	12,000.0	EPA
Vinyl Chloride	x		2.0	MCL
m-Xylene	x		175.0	DWEL
p-Xylene	x		175.0	DWEL
PESTICIDES AND PCBs				
Aldrin		x	0.004	CLP
DDT		x	0.012	CLP
PCBs		x	0.5	PMCL

EXHIBIT 15
(Continued)

PROPOSED CHEMICAL SPECIFIC ARARS FOR HENDERSON ROAD SITE INECTION WELL AND LANDFILL OPERABLE UNITS*

PMCL - Proposed Maximim Contaminant Level (SDWA)
MCL - Maximim Contaminant Level (SDWA)
MCLG - Maximim Contaminant Level Goals (SDWA)
NIPDWR - National Interim Primary Drinking Water Regulation (Safe Drinking Water Act)
CLP - USEPA CLP detection limit
AWQC - Ambient Water Quality Criteria
SNARL - Suggested No Adverse Effect Level
DWEL - Drinking Water Equivalent Level
EPA - Recommended by EPA
Ma - Model in Appendix A of RI
Mc - Organoleptic
*** - EPA Superfund Public Health Evaluation Manual, DER, Washington, DC
EPA 54011 - 861060 (OSWER Directive 9,285.4-1), Ocyober, 1986
a - This value is for total trihalomethanes
b - Alternate concentration limit based on background contamination
( ) - numbers and letter in parentheses are related to each other for chemical in that rov. Value represent changes in the Safe Drinking Water Act MCLs since the IWOU-ROD
IWOU - Chemicals are based on Exhibit 16 of the IWOU-ROD.
LOU - Chemicals are based on Table 2-4 of the LOU Draft FS.

* The basis for proposed ARAR's is that the site is located above a Class IIA aquifer.

EXHIBIT 16

SUMMARY OF RISK ESTIMATES

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT
(Based on 7/12/89 Revisions to Risk Tables
Submitted by BCM)

Exposure Pathway	Individual Cancer Risk		Hazard Index	
	Maximum	Average	Maximum	Average
Inhalation of fugitive emissions				
1. On-site workers	2.4×10^{-4}	1.8×10^{-5}	0.160	0.026
2. Area residents (within approx. 1 km)	9×10^{-7}	7×10^{-8}	0.0005	0.0001
Ingestion of soil				
1. On-site workers	1.5×10^{-3}	6.8×10^{-5}	0.39	0.035
2. Trespassers	7×10^{-5}	3×10^{-6}	0.913	0.081
Residential use of groundwater	8.4×10^{-3}	3.8×10^{-3}	3.9	0.4

Source: BMC Engineers (Project No. 00-5808-02)

EXHIBIT 16

INDIVIDUAL CARCINOGENIC RISK
INHALATION OF FUGITIVE EMISSIONS

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

	Individual Cancer Risk			
	Reference[a] (1 ug/m^3)		Maximum[a] (263 ug/m^3)	
Chemical	Maximum[b]	Average[b]	Maximum[b]	Average[b]
Aldrin	$<1 \times 10^{-8}$	$<1 \times 10^{-8}$	$<1 \times 10^{-8}$	$<1 \times 10^{-8}$
Benzene	$<1 \times 10^{-8}$	$<1 \times 10^{-8}$	$<1 \times 10^{-8}$	$<1 \times 10^{-8}$
Benzidine	1×10^{-7}	1×10^{-8}	3.7×10^{-5}	3×10^{-6}
Bis(2-chloroethyl) ether	1×10^{-8}	$<1 \times 10^{-8}$	1×10^{-6}	2×10^{-8}
Chloroform	$<1 \times 10^{-8}$	$<1 \times 10^{-8}$	$<1 \times 10^{-8}$	$<1 \times 10^{-8}$
Chromium**	7×10^{-7}	6×10^{-8c}	1.8×10^{-4}	1.5×10^{-5c}
4,4'-DDT	$<1 \times 10^{-8}$	$<1 \times 10^{-8}$	$<1 \times 10^{-8}$	$<1 \times 10^{-8}$
Hexachlorobenzene	1×10^{-8}	$<1 \times 10^{-8}$	2.6×10^{-6}	4×10^{-8}
Hexachlorobutadiene	$<1 \times 10^{-8}$	$<1 \times 10^{-8}$	$<1 \times 10^{-8}$	$<1 \times 10^{-8}$
1,3-Dichloropropene	$<1 \times 10^{-8}$	$<1 \times 10^{-8}$	$<1 \times 10^{-8}$	$<1 \times 10^{-8}$
PCBs	$<1 \times 10^{-8}$	$<1 \times 10^{-8}$	$<8 \times 10^{-7}$	$<1 \times 10^{-8}$
Tetrachloroethene	$<1 \times 10^{-8}$	$<1 \times 10^{-8}$	$<1 \times 10^{-8}$	$<1 \times 10^{-8}$
Trichloroethene	$<1 \times 10^{-8}$	$<1 \times 10^{-8}$	$<1 \times 10^{-8}$	$<1 \times 10^{-8}$
PAHs	7×10^{-8}	$<1 \times 10^{-8}$	1.9×10^{-5}	2×10^{-7}
TOTAL	9×10^{-7}	7×10^{-8}	2.4×10^{-4}	1.8×10^{-5}

Note: Individual Cancer Risk = Potency Factor x Chronic Daily Intake, where Chronic Daily Intake =

$$\frac{\text{mg chemical}^{d}}{\text{Kg soil}} \times \frac{\text{kg soil}}{\text{m}^3\text{ air}} \times \frac{20\text{m}^3}{\text{day}} \times \frac{250\text{d}^*}{365\text{d}} \times \frac{30\text{y}^*}{70\text{y}} \times \frac{1}{70\text{ kg b.wt.}}$$

The assumptions used in calculating the CDI are discussed in Section 5.5.1.1.

* Not included for area residents.

** The analytical technique did not distinguish between the trivalent and hexavalent forms. Assumed to be 100 percent hexavalent to represent worst case.

[a] Concentration of soil in air

[b] Concentration of chemical in soil

[c] Average concentration below background

[d] Table 5-10

Source: BCM Engineers (Project No. 00-5808-02) (REVISED 7/12/89)

EXHIBIT 16

INDIVIDUAL CARCINOGENIC RISK
INGESTION OF SOIL BY ONSITE WORKERS

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

Chemical	Individual Cancer Risk*	
	Maximum	Average
Benzidine	7.03×10^{-4}	6.1×10^{-5}
PAHs	6.94×10^{-4}	6.0×10^{-6}
Hexachlorobenzene	4.9×10^{-5}	7.0×10^{-7}
PCBs	1.6×10^{-5}	$<1.0 \times 10^{-8}$
Bis(2-chloroethyl)ether	2.9×10^{-5}	4.0×10^{-7}
Hexachlorobutadiene	2.0×10^{-6}	3.0×10^{-8}
Tetrachloroethene	9.0×10^{-8}	$<1.0 \times 10^{-8}$
Aldrin	2.0×10^{-8}	$<1.0 \times 10^{-8}$
Trichloroethene	2.0×10^{-8}	$<1.0 \times 10^{-8}$
4,4'-DDT	1.0×10^{-8}	$<1.0 \times 10^{-8}$
1,3-Dichloropropene	$<1.0 \times 10^{-8}$	$<1.0 \times 10^{-8}$
Benzene	$<1.0 \times 10^{-8}$	$<1.0 \times 10^{-8}$
Chloroform	$<1.0 \times 10^{-8}$	$<1.0 \times 10^{-8}$
Total	1.49×10^{-3}	6.8×10^{-5}

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a Table 5-10.

* Individual Cancer Risk = Potency Factor x Chronic Daily Intake, where:

$$\text{Chronic Daily Intake} = \frac{\text{mg chemical}^{a}}{\text{Kg soil}} \times \frac{1}{\text{70 Kg b.wt.}} \times \frac{1\times10^{-4}\ \text{Kg soil}}{\text{day}} \times \frac{250\text{d}}{365\text{d}} \times \frac{30\text{y}}{70\text{y}}$$

The assumptions used in calculating the CDI are discussed in Section 5.5.1.2.

Source: BCM Engineers (Project No. 00-5808-02) (REVISED 7/12/89)

EXHIBIT 16

INDIVIDUAL CARCINOGENIC RISK
RESIDENTIAL USE OF GROUNDWATER AT THE PROPERTY LINE

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

	Individual Cancer Risk*			
	Maximum		Average	
Chemical	Ingestion	Inhalation	Ingestion	Inhalation
PAHs	4.06×10^{-3}	9.78×10^{-4}	3.03×10^{-3}	5.0×10^{-4}
Aldrin	1.18×10^{-3}	2.21×10^{-4}	6.6×10^{-5}	1.2×10^{-5}
Bis(2-chloroethyl)ether	4.34×10^{-4}	4.12×10^{-4}	4.7×10^{-5}	4.4×10^{-5}
PCBs	4.29×10^{-4}	4.08×10^{-4}	1.0×10^{-7}	1.0×10^{-7}
Hexachlorobenzene	1.16×10^{-4}	1.10×10^{-4}	4.6×10^{-5}	4.3×10^{-5}
Benzene	1.9×10^{-5}	1.8×10^{-5}	5.6×10^{-7}	5.0×10^{-7}
Hexachlorobutadiene	1.2×10^{-5}	1.1×10^{-5}	1.1×10^{-5}	1.0×10^{-5}
1,3-Dichloropropene	8.0×10^{-6}	7.0×10^{-6}	1.0×10^{-6}	1.0×10^{-6}
Chloroform	8.0×10^{-7}	7.6×10^{-7}	3.7×10^{-8}	3.5×10^{-8}
Tetrachloroethene	8.0×10^{-6}	7.3×10^{-6}	3.0×10^{-7}	3.0×10^{-7}
4,4'-DDT	5.0×10^{-6}	4.0×10^{-6}	5.0×10^{-6}	4.0×10^{-6}
Trichloroethene	7.0×10^{-7}	6.0×10^{-7}	6.0×10^{-8}	5.0×10^{-8}
Sub-Total	6.26×10^{-3}	2.18×10^{-3}	3.21×10^{-3}	6.15×10^{-4}
TOTAL	8.44×10^{-3}		3.82×10^{-3}	

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* Individual Cancer Risk = Potency Factor × Chronic Daily Intake (CDI), where:

$$\text{CDI-ingestion} = \frac{\text{mg chemical}^{a}}{\text{liter}} \times \frac{\text{2 liters}}{\text{day}} \times \frac{1}{\text{70 kg b.wt.}} \times 0.15$$

0.15 = Groundwater dilution factor

CDI-inhalation = (CDI-ingestion × 0.95⁺)

(⁺ 0.95 = Correction factor to include exposure via inhalation for all chemicals except fluorene, anthracene, aldrin, and DDT which have factors of 0.19 [see Section 5.5.1.3])

a Table 5-10

The assumptions used in calculating the CDI are discussed in Section 5.5.1.3.

Source: BCM Engineers (Project No. 00-5808-02) (REVISED 7/12/89)

EXHIBIT 16

NONCARCINOGENIC RISK
RESIDENTIAL USE OF WATER AT THE PROPERTY LINE

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

	Hazard Index*			
	Maximum		Average	
Chemical	Ingestion	Inhalation	Ingestion	Inhalation
Aldrin	2.32	0.44	0.13	0.02
DDT	0.03	0.005	0.03	0.005
1,3-Dichloropropene	0.15	0.14	0.016	0.015
Hexachlorobenzene	0.09	0.08	0.034	0.032
Hexachlorobutadiene	0.07	0.07	0.07	0.07
Lead	0.08	—	0.009	—
Tetrachloroethene	0.015	0.014	0.0006	0.0005
Chloroform	0.013	0.012	0.0006	0.0006
Toluene	0.012	0.003	0.003	0.0009
Chromium	0.009	—	0.004	—
Trichlorofluoromethane	0.005	0.008	0.0002	0.0003
Ethylbenzene	0.002	0.002	0.0005	0.0004
Barium	0.0023	—	0.0023	—
Sub-Total	2.8	0.77	0.32	0.13
TOTAL	3.6		0.45	

$$\text{* Hazard Index} = \frac{\text{Chronic Daily Intake (CDI)}}{\text{Reference Dose}}$$

where:

$$\text{CDI-Ingestion} = \frac{\text{mg chemical}}{\text{liter}} \times \frac{\text{2 liters}}{\text{day}} \times \frac{1}{\text{70 kg b. wt.}} \times 0.15$$

$$\text{CDI-Inhalation} = (\text{CDI-Ingestion}) \times 0.95^{+}$$

($^{+}$ 0.95 = Drinking water equivalent for all chemicals except Aldrin and DDT, for which 0.19 was used.)

Groundwater dilution factor = 0.15

Source: BCM Engineers (Project No. 00-5808-02)

EXHIBIT 16

NONCARCINOGENIC RISK
INGESTION OF SOIL BY TRESPASSERS

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

Chemical	Hazard Index* Maximum	Hazard Index* Average
Lead	0.37	0.06
Chromium	0.13	0.011
Hexachlorobenzene	0.29	0.004
Hexachlorobutadiene	0.09	0.002
Barium	0.017	0.003
Benzidine	0.012	0.0011
Tetrachloroethene	0.0014	<0.0001
1,3-Dichloropropene	0.0006	0.0001
Aldrin	0.0003	<0.0001
DDT	0.0002	<0.0001
Ethylbenzene	0.0001	<0.0001
Toluene	0.0001	<0.0001
Trichlorofluoromethane	<0.0001	<0.0001
Chloroform	<0.0001	<0.0001
TOTAL	0.9	0.08

$$* \quad \text{Hazard Index} = \frac{\text{Chronic Daily Intake}}{\text{Reference Dose}}$$

where:

$$\text{Chronic Daily Intake} = \frac{\text{mg chemical}^{a}}{\text{Kg soil}} \times \frac{1}{\text{30 Kg b.wt.}} \times \frac{1\times10^{-4}\ \text{Kg soil}}{\text{day}}$$

a Table 5-10

Source: BCM Engineers (Project No. 00-5808-02)

EXHIBIT 16

NONCARCINOGENIC RISK
INGESTION OF SOIL BY ONSITE WORKERS

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

Chemical	Hazard Index Maximum	Hazard Index Average
Lead	0.16	0.03
Hexachlorobenzene	0.12	0.0018
Chromium	0.06	0.005
Hexachlorobutadiene	0.04	0.0007
Barium	0.007	0.0011
Benzidine	0.005	0.0005
Tetrachloroethene	0.0005	<0.0001
1,3-Dichloropropene	0.0002	<0.0001
Aldrin	0.0001	<0.0001
DDT	0.0001	<0.0001
Ethylbenzene	0.0001	<0.0001
Toluene	<0.0001	<0.0001
Trichlorofluoromethane	<0.0001	<0.0001
Chloroform	<0.0001	<0.0001
TOTAL	0.39	0.04

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* Hazard Index = $\frac{\text{Chronic Daily Intake}}{\text{Reference Dose}}$

where:

$$\text{Chronic Daily Intake} = \frac{\text{mg chemical}^{a}}{\text{Kg soil}} \times \frac{1}{\text{70 Kg b.wt.}} \times \frac{1\text{x}10^{-4}\text{ Kg soil}}{\text{day}}$$

a Table 5-10

Source: BCM Engineers (Project No. 00-5808-02)

EXHIBIT 16

NONCARCINOGENIC RISK
INHALATION OF FUGITIVE EMISSIONS

HENDERSON ROAD SITE
LANDFILL OPERABLE UNIT

	Hazard Index			
	Reference[a] (1 ug/m^3)		Maximum[a] (263 ug/m^3)	
Chemical	Maximum[b]	Average[b]	Maximum[b]	Average[b]
Barium	0.0005	0.0001	0.14	0.02
1,3-Dichloropropene	<0.0001	<0.0001	<0.0001	<0.0001
Ethylbenzene	<0.0001	<0.0001	<0.0001	<0.0001
Tetrachloroethene	<0.0001	<0.0001	<0.0001	<0.0001
Toluene	<0.0001	<0.0001	<0.0001	<0.0001
Trichlorofluoromethane	<0.0001	<0.0001	<0.0001	<0.0001
Chloroform	<0.0001	<0.0001	<0.0001	<0.0001
Hexachlorobenzene	<0.0001	<0.0001	0.0065	0.0001
Hexachlorobutadiene	<0.0001	<0.0001	0.0021	<0.0001
Lead	<0.0001	<0.0001	0.0084	0.0013
Chromium	<0.0001	<0.0001	0.0030	0.0002
Benzidine	<0.0001	<0.0001	0.0003	<0.0001
Aldrin	<0.0001	<0.0001	<0.0001	<0.0001
DDT	<0.0001	<0.0001	<0.0001	<0.0001
TOTAL	0.0005	0.0001	0.16	0.022

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[a] Concentration of soil in air
[b] Concentration of chemical in soil
[c] Table 5-10

Note: Hazard Index = $\frac{\text{Chronic Daily Intake}}{\text{Reference Dose}}$

where:

$$\text{Chronic Daily Intake} = \frac{\text{mg chemical}^{c}}{\text{Kg soil}} \times \frac{\text{kg soil}}{\text{m}^3\text{ air}} \times \frac{20\text{m}^3}{\text{day}} \times \frac{1}{70\text{ kg b.wt.}}$$

Source: BCM Engineers (Project No. 00-5808-02)

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